Winning Strategies for Japan and Japanese Industries

Putting an End to the "Lost Decades"

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Summary 1/2

- Since the bursting of the bubble economy, Japan's economy has been in a long period of stagnation that is colloquially known as the "lost decades." Due to the effects of the weaker yen, Japan's GDP in nominal terms in 2023 has fallen back to being the fourth largest in the world for the first time in 56 years since 1967, having been overtaken by Germany. Some view this as a transitory foreign exchange factor, but, looking out at the next 20 or 30 years, scenarios can be envisioned in which countries such as India and Indonesia have continued population growth and see their economies expand while Japan's international standing further declines.
- On the other hand, Japanese companies' performance has remained strong, boosted by the resumption of economic activity following the COVID-19 pandemic, and, in contrast to the above, by the positive effects of the yen's depreciation. Thanks in part to an influx of funds from overseas investors, Japanese stocks have hit a new all-time high, and there are rising expectations for wage increases and an end to deflation. While there are positive signs that the Japanese economy is making a resurgence, it goes without saying that, in order to put an end to the "lost decades," a prerequisite is the sustainable growth of Japanese companies and of Japanese industries (aggregates of these companies).
- Japanese industry has a history of being driven by manufacturing, which has traditionally been referred to as *monozukuri* in Japanese. Many Japanese companies have a strong global presence from creating high value-added products, which they do by leveraging their strengths such as workplace *kaizen*[*1] capabilities and *suriawase*[*2] that takes advantage of industrial clusters. Among them, the automobile industry is the core of Japan's manufacturing industry.
- Japan's automobile industry has been highly praised in many countries and regions around the world due to its high quality and economic efficiency, and, in addition to the automobiles themselves, has developed both domestically and internationally along with peripheral industries such as automobile parts, machinery and equipment, and materials. However, the industry is now at a crossroads due to changing trends that have occurred since the industry's inception, such as the shift to electrification and vehicle intelligence.
- In order for Japan‘s automobile industry to survive and thrive the fierce competition, transforming its business model will be essential, shifting value from the traditional emphasis on "function" to "experience" in order to meet changing consumer needs and social structures. What will determine the outcome here are cyber physical systems (CPS), advanced fusions of real and virtual spaces that create new strengths and compensates for weaknesses.
- CPS can be expected to have both offensive and defensive effects, such as improving production efficiency, passing on skills, strengthening the workforce, and creating new added value. This is a theme that should be addressed not only by the automotive industry, but by all Japanese industries, both manufacturing and non-manufacturing, where "human" issues such as low productivity and labor shortages are becoming increasingly serious.
- This presentation reviews the current situation for Japan and Japanese industry, and then maps out winning strategies for Japan and Japanese industry based on structural changes in the automobile industry, the utilization of CPS, and their effects. The structure and contents of each chapter are as shown on the following pages.

Note 1: *Kaizen* is a Japanese term for the process of continuous improvement of business activities by all employees at a company.
Note 2: *Suriawase* is a Japanese term for the process of coordination, fine-tuning, and precision integration between OEMs and suppliers to achieve a desired result.

Summary 2/2

- Chapter I summarizes Japan's current situation from the perspectives of its current account balance, fiscal balance, demographic trends, and economic security. In terms of its current account balance, Japan's deteriorating trade balance has put the country on track to become a credit disposition nation, while, in terms its fiscal balance, Japan's aging population has made it difficult to halt the growth of annual expenditures. Additionally, amidst rising geopolitical risks, Japan has a low energy and food self-sufficiency rate, and there are concerns that it will lose out on being able to purchase during normal times and that it will be unable to purchase during emergencies.
- Chapter II discusses the current state of Japanese industry, particularly the automobile industry's contributions and structural changes. The automobile industry has been the driving force behind the growth of Japanese industry over the past two decades. While it has achieved growth together with peripheral industries such as automobile parts, machinery and equipment, and materials, the automobile industry is now being confronted with a period of major transformation in response to changes in consumer needs and social structure, including the shift to electrification and vehicle intelligence.
- Chapter III provides an overview of CPS. By fusing real and virtual spaces, CPS have the potential to solve problems that Japan and Japanese industry have been confronted with in the past, such as analyzing the past, predicting the future, and converting tacit knowledge into explicit knowledge. With the emergence of generative AI and the future development of AGI, the evolution of AI is expected to expand and increase the sophistication of the areas in which AI is utilized, and Japan, with its strengths in sensing and actuation, is well-positioned to take the lead over other countries.
- Chapter IV considers changes in the automobile industry and the impacts of CPS utilization. In the manufacturing industry, it will be necessary to restructure production systems and to build new mechanisms for value creation, and both manufacturing and non-manufacturing industries will be able to provide new value, such as improving efficiency and the creation of services that transcend industries boundaries.
- Chapter V, based on the strengths of Japanese industry, identifies winning strategies for three areas via the utilization of CPS: 1) "UX/Contents" to shift the value being provided from 'functions' to 'experiences'; 2) "Components" that grow complementary to each other by leveraging existing strengths; and 3) "Solving Social Issues" by leveraging data and know-how to break through the current status quo where only issues receive precedence.
- Finally, this presentation depicts a future for Japan and Japanese industries that have set out on the path towards winning strategies. As Japanese industry increases its added value and regains its earning power, it is expected that it will more actively invest in human resources for sustainable growth. It is also hoped that Japan will continue to develop in 2050 and beyond as it changes the allocation of its investment resources from the past to the future.

Composition of this presentation (table of contents)

[Chapter I]	[Chapter II]	[Chapter III]	[Chapter IV]	[Chapter V]	Conclusion
Japan's Current Situation	Reviewing Japanese Industry	Utilizing CPS	Automobiles and the Impact of CPS	Winning Strategies	A Future on the Path Towards Winning Strategies
• Deteriorating current account balance and fiscal balance • Slump in GDP growth • Economic security (low energy and food self-sufficiency rate)	• World-class manufacturing industry • Automobile industry's contribution, and current trends • Pressure to decarbonize	• Human issues (productivity, labor shortages, passing on skills) • Changes in the environment from the past (AI) • Challenges to spread	• *Monozukuri*: Impact on quality, quantity, and operations • Services: Power, efficiency, and the birth of new businesses	• UX/Contents • Components • Solving social issues	• Covering for the decline in existing automobile fields • Current account surplus • Reclaiming earning power (manufacturing industry) • Active participation by the elderly

Note: CPS is an abbreviation for "Cyber Physical Systems"
Source: Compiled by Mizuho Bank Industry Research Department

Highlights: Achieving sustainable growth by leveraging the strengths of Japan and Japanese industry

Japan and Japanese industry: The current unsustainable situation, stemming from human issues

(1) People

- Declining birthrate and aging population: Japan's birth rate has fallen below 1.3 due to the impact of COVID-19, and is on the verge of having 30% of its population be elderly
- Population decline: Japan's working-age population turned negative in 1995, and is expected to decline by approx. 1% every year going forward

(2) Goods and services

- Manufacturing industry: Leading the world with craftsmanship, but human issues such as labor shortages and passing on skills are becoming apparent
- Non-manufacturing industry: Provides a high level of service but has productivity issues. Similar to the manufacturing industry, has serious labor shortages

(3) Money

- Current account balance: Japan is no longer earning from trade, and its services balance is in a constant deficit. Japan is in view of being a credit disposition nation
- Public finances: Annual expenditures, particularly for social security, are increasing due to the aging population. Deficits are being covered government bonds

Automobiles: Impact on Japanese industry due to structural changes

- Advancing electrification and vehicle intelligence: Risk of losing traditional strengths such as craftsmanship, tacit knowledge, cost control, and price control
- There are imminent major structural changes in the automobile industry, which is at the core of Japan's industrial clusters, and, as production and R&D systems are reviewed, the impacts are expected to spread to peripheral industries such as parts and materials

CPS: Compensating for weaknesses and reinforcing strengths

- The advanced fusion of real and virtual spaces will solve human issues, such as improving production efficiency and strengthening the labor force. Furthermore, they will give rise to new services that transcend industry boundaries
- Manufacturing and non-manufacturing industries, which have differentiated themselves based on the quality, functionality, and economic efficiency of their products and services, will shift the source of their strength to data

Three winning strategies for Japan and Japanese industry

UX/Contents ~Evolving strengths to the next generation

- Traditionally, functionality, ownership, and exclusivity were important factors when customers selected goods and services
- CPS realizes "experiential" value, which is more important to Generation Z and Generation Alpha, who will become the core consumers

Components ~Further deepening strengths

- Demand for electronic components such as motors and sensors, as well as for their materials, is expected to grow as CPS become more widespread
- CPS effectiveness is enhanced by the complementary relationships between high performance/high quality parts and materials

Solving social issues ~Changing weaknesses to strengths

- Japan will use its experience, data, and know-how, etc. to solve problems ahead of other countries and then deploy its successful experiences overseas
- Currently, most cases are progressing only on issues, but the use of CPS will promote demonstrations and practical applications

A future on the path towards winning strategies

- Take domestically-created value and deploy it overseas. Taking wealth acquired overseas and returning it to Japan will establish a virtuous cycle between Japan and overseas
- Higher value-added: Increase added value by improving production efficiency. It is expected that there will be increased earning power and further investments in human capital

Towards a sustainable Japan and Japanese industry

- In the era of 100-year lifespans, the use of CPS will enable the elderly to continue to play an active role on at the forefront and lead more fulfilling lives than before
- Shift resources to investments in the next generation, focusing on science and technology, while reducing returns to the past. Automation, autonomy, and self-sufficiency will lead to "still unexplored winning strategies" that will lead to the future in 2050 and beyond

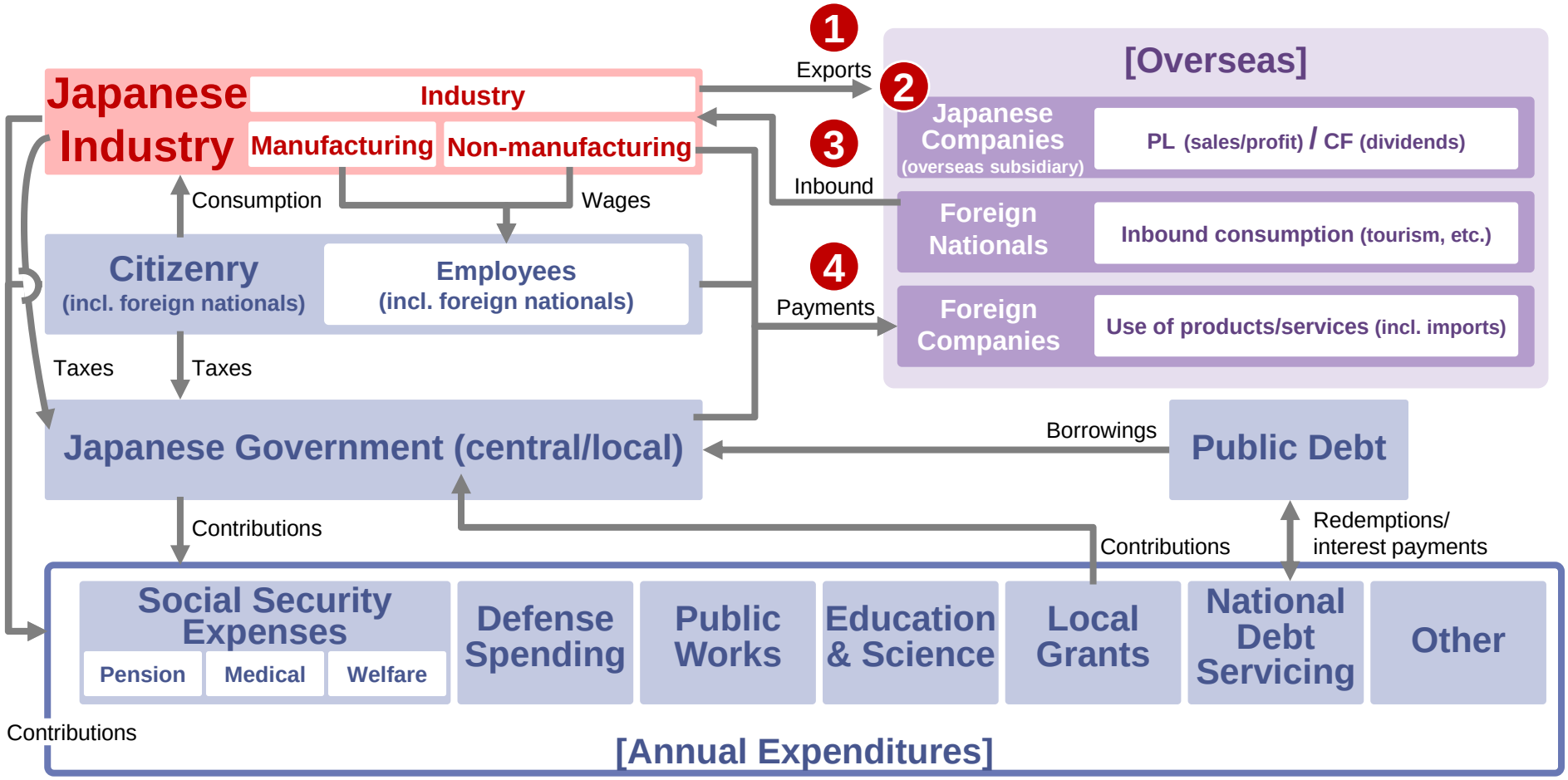
Source: Compiled by Mizuho Bank Industry Research Department

"Winning" elements in "winning strategies"

- **Increase positives: (1) Exports, (2) Overseas businesses, (3) Inbound**
- **Decrease negatives: (4) Payments to overseas companies**

- This report defines "winning" elements as two points: increasing positives ((1) increasing exports, (2) expanding overseas businesses, and (3) increasing inbound revenue) and decreasing negatives ((4) decreasing payments to overseas companies).

The way of thinking of "Winning"



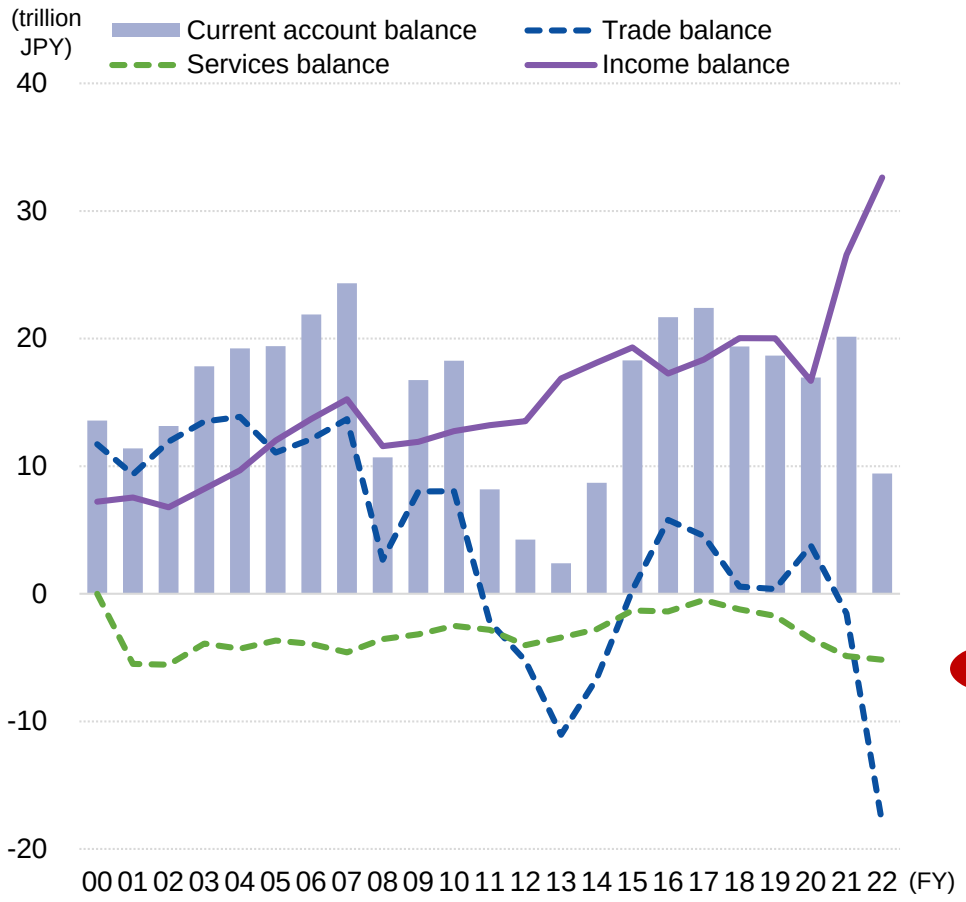
Source: Compiled by Mizuho Bank Industry Research Department

I. Japan's Current Situation: A Dim Future for "Business as Usual"

Reviewing Japan's current account balance: How long will Japan's status as a "mature creditor nation" last?

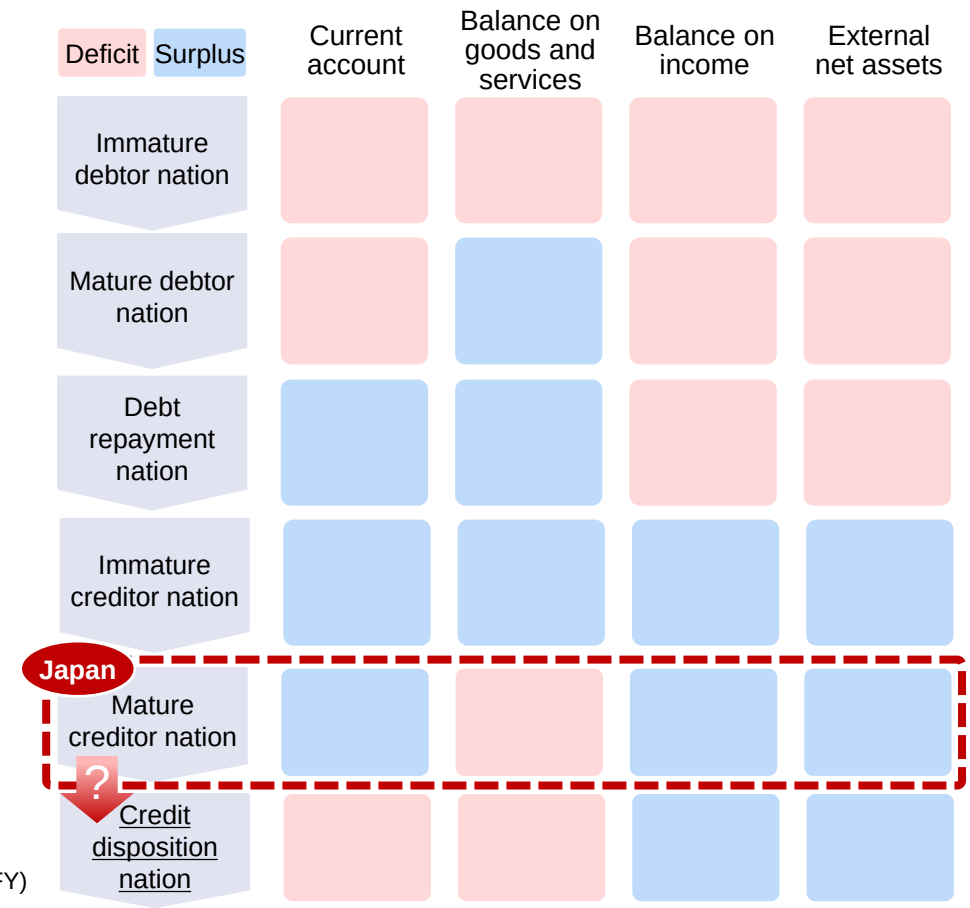
- The earning power of Japan's trade balance, once its main earner, has declined, and deficits in the service balance have become the norm. Although right now the current account balance is maintaining a surplus via the income balance, which is the return on past investments, in the future there is a risk that Japan will shift to being a credit disposition nation.

Trends in current account balance (FY2000-2022)



Source: Compiled by Mizuho Bank Industry Research Department based on Ministry of Finance materials

International balance of payments development stage theory (Crowther, 1957)

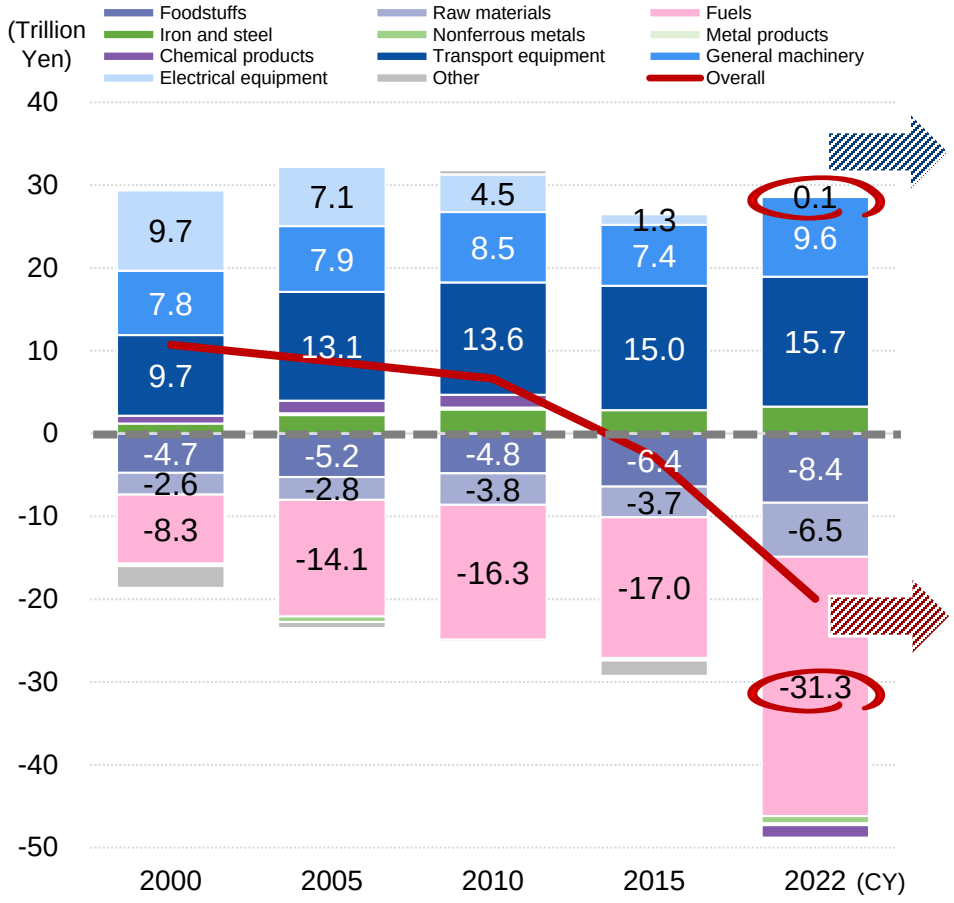


Source: Compiled by Mizuho Bank Industry Research Department based on publicly available information

Reviewing the balance of trade: The importance of automobiles has significantly increased over the past 20 years

- While electrical machinery, which used to earn JPY 10 trillion in net exports and imports, has declined to an equilibrium level, imports significantly increased in 2022, partly due to the soaring prices of raw materials and fuels. On the other hand, automobiles and machinery are the main drivers for exports.

Trends in trade balance (export/import net) (2000-2022)



<Electrical Machinery>

- Imports increase more than exports (2000→2022)
  - ・Exports +JPY 3.6 trillion; imports +JPY 13.2 trillion

<Factors for increase/decrease in exports>

- Increase: Semiconductors (+JPY 1.0 trillion), electrical measuring instruments (+JPY 1.1 trillion), electrical circuits (+JPY 1.5 trillion)
- Decrease: Audio/visual equipment (-JPY 1.3 trillion), communication equipment (-JPY 0.5 trillion)

<Increase in imports>

- Communications equipment (+JPY 3.2 trillion), semiconductors (+JPY 2.0 trillion)

<Fuels>

- Imports significantly increased (2000→2022)
  - ・+JPY 25.2 trillion

<Factors for increase in imports>

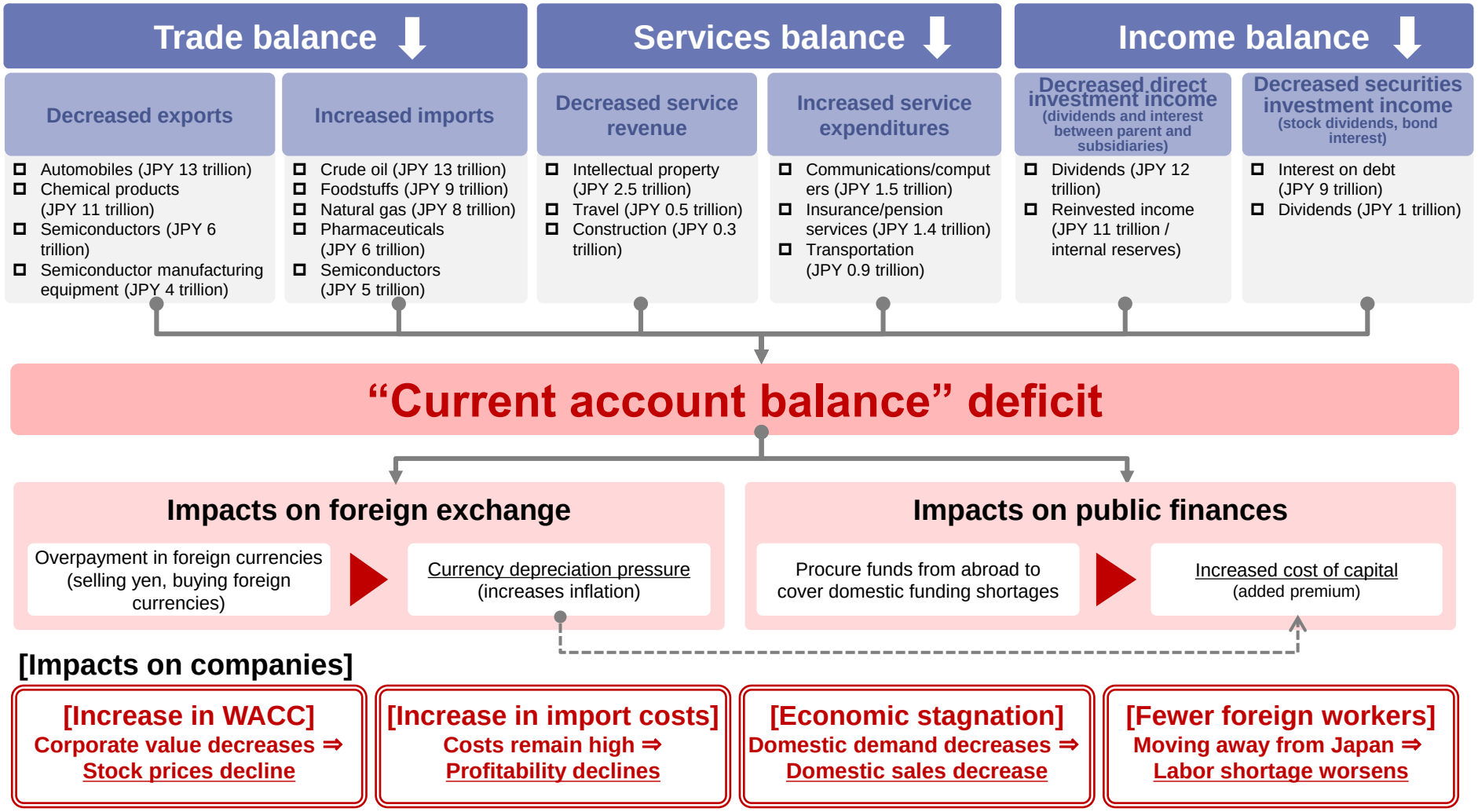
- Increase: Crude oil (+JPY 8.5 trillion), coal (+JPY7.2 trillion), natural gas (+JPY 7.0 trillion)
  - ・Power source composition during same period (2000→2021):
    Nuclear power -27%, coal +23%, natural gas +8%, renewable energy +10%

Note: Electrical equipment is the total of audiovisual equipment, communications equipment, electronic components such as semiconductors, and electrical measuring instruments

Source: Compiled by Mizuho Bank Industry Research Department based on "Trade Statistics of Japan" by the Ministry of Finance

Negative impacts expected from transition to being a credit disposition nation (current account balance deficit)

- If the trade balance and services balance, etc. deteriorate and the current account balance deficit becomes permanent, then negative impacts on companies will be inevitable.



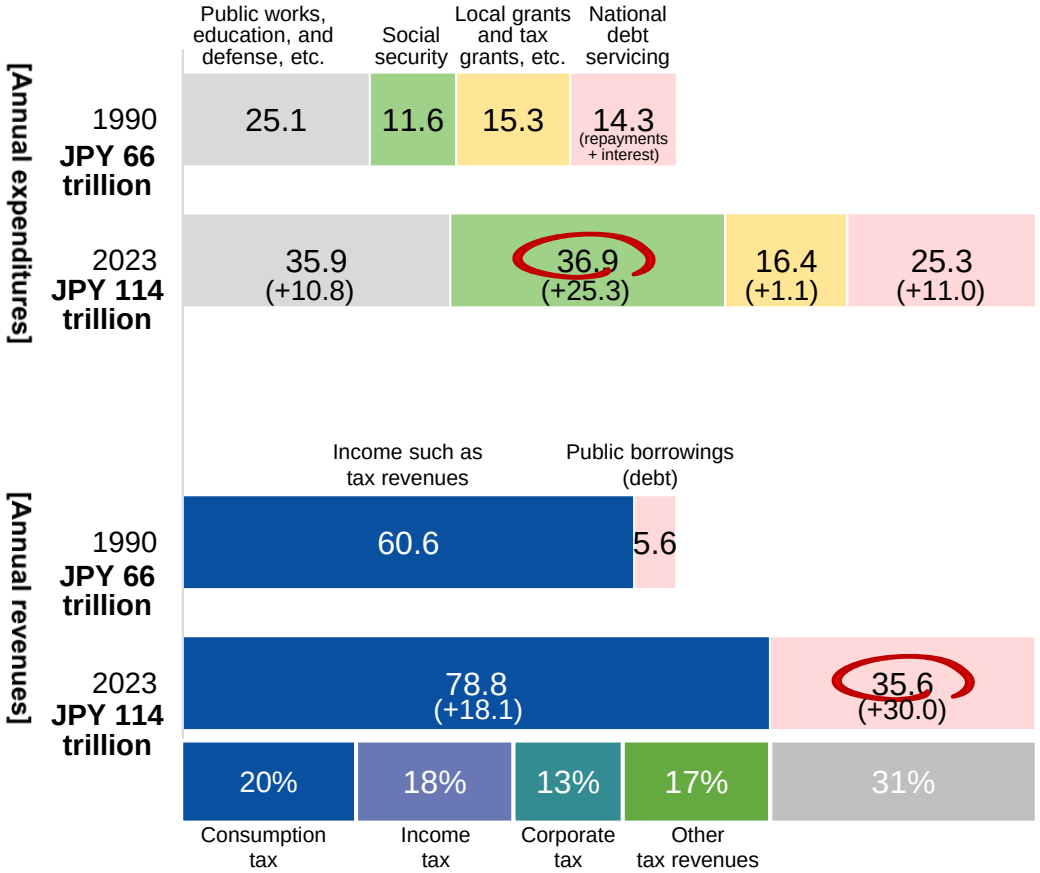
Note: The figures for trade balance, services balance, and income balance are the actual results for FY2022.
Source: Compiled by Mizuho Bank Industry Research Department based on Ministry of Finance materials

Reviewing the fiscal balance: Outstanding balance for ordinary JGBs exceeded JPY 1,000 trillion in 2022

- Although there has been some increase in tax revenues, such as the consumption tax, most of the increases in annual expenditures centered around social security have been covered by JGBs. Expenditures are expected to continue to increase in social security, defense, and public works projects, etc.

Current status of and future outlook for the fiscal balance (based on FY2023 budget)

<Changes in annual expenditures (upper rows) and annual revenue (lower rows)>



[Annual expenditures may swell in the future]

<Social security>

Due to Japan's aging population, medical and nursing care benefit costs (planned basis) are expected to exceed JPY 90 trillion in 2040, up from approx. JPY 50 trillion in 2018

<Defense>

The unwritten rule until FY2022 was 1% of GDP (more than JPY 5 trillion), but is expected to increase to 2% (approx. JPY 11 trillion) in FY2027 in response to growing security concerns

<Public works (infrastructure)>

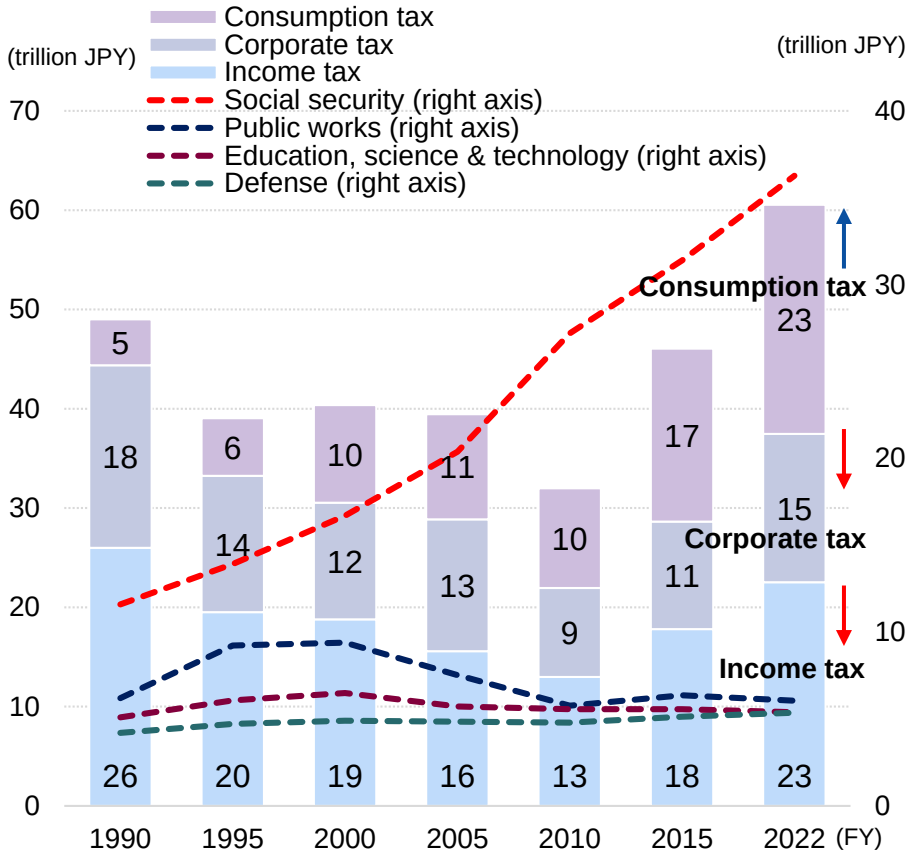
Maintenance costs are expected to increase as the infrastructure developed during the period of high economic growth rapidly deteriorates (+JPY 1.0~1.5 trillion from JPY 5.2 trillion in FY2018)

Source: Compiled by Mizuho Bank Industry Research Department based on Ministry of Finance materials and Ministry of Health, Labour and Welfare materials

Reviewing the fiscal balance: Trends in tax revenue and annual expenditures, and comparison with other countries

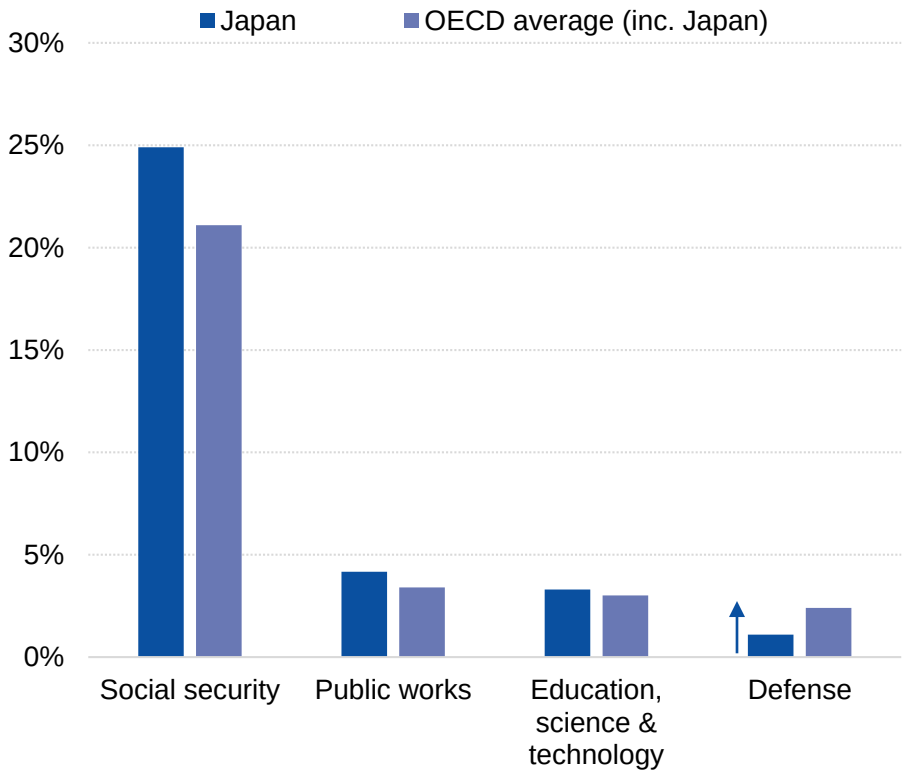
- Since FY2000, there has been an accelerating trend of cutting non-social security annual expenditures and allocating money via consumption tax hikes to the ever-increasing social security costs. Discussions are also currently underway to raise defense spending to a level comparable to that of the G7 (2%).

Trends in tax revenue and annual expenditures (FY1990-2022)



Note: Arrows indicate increase/decrease compared to 1990.
Source: Compiled by Mizuho Bank Industry Research Department based on Ministry of Finance materials

Composition ratio comparison of various annual expenditures in GDP



Note: Social security includes social spending (2022); Public works includes government investment spending (2021); Education, science & technology includes R&D expenditures (2021); and Defense includes military expenditures (2022)
Source: Compiled by Mizuho Bank Industry Research Department based on OECD.Stat and World Bank

The future as seen from demographic trends: Risk that Japan's status as an economic power will gradually decline

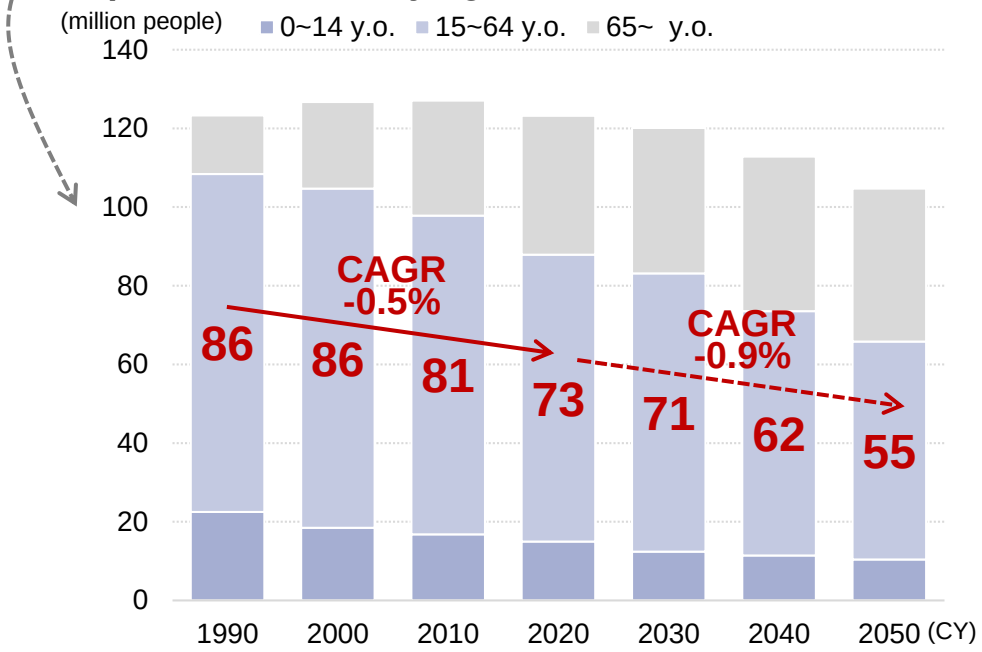
- In 2023, in part due to the impact of exchange rates, Japan was overtaken by Germany in terms of nominal GDP, and, for the first time in 56 years, fell back to being the fourth largest economy in the world.
- Going forward, it is expected that Japan's ranking will gradually decline as populous countries such as India and Indonesia continue to grow.

Trends in population and real GDP (forecast)

<Potential growth rate>

Labor inputs	Total factor productivity	Capital inputs
No. of employees x working hours	Production efficiency	Equipment (capital stock)

<Population trends by age>



<Trends in real GDP (estimates)>

	2022	2030e	2040e	2050e
1	US	US	China	China
2	China	China	US	US
3	Japan	India	India	India
4	Germany	Germany	Germany	Indonesia
5	India	Japan	Japan	Germany
6	UK	UK	UK	Japan
7	France	France	Indonesia	UK
8	Canada	Brazil	France	Brazil
9	Russia	Canada	Brazil	France
10	Italy	Italy	Canada	Russia

Move up due to population bonus

Falls to 6th place globally

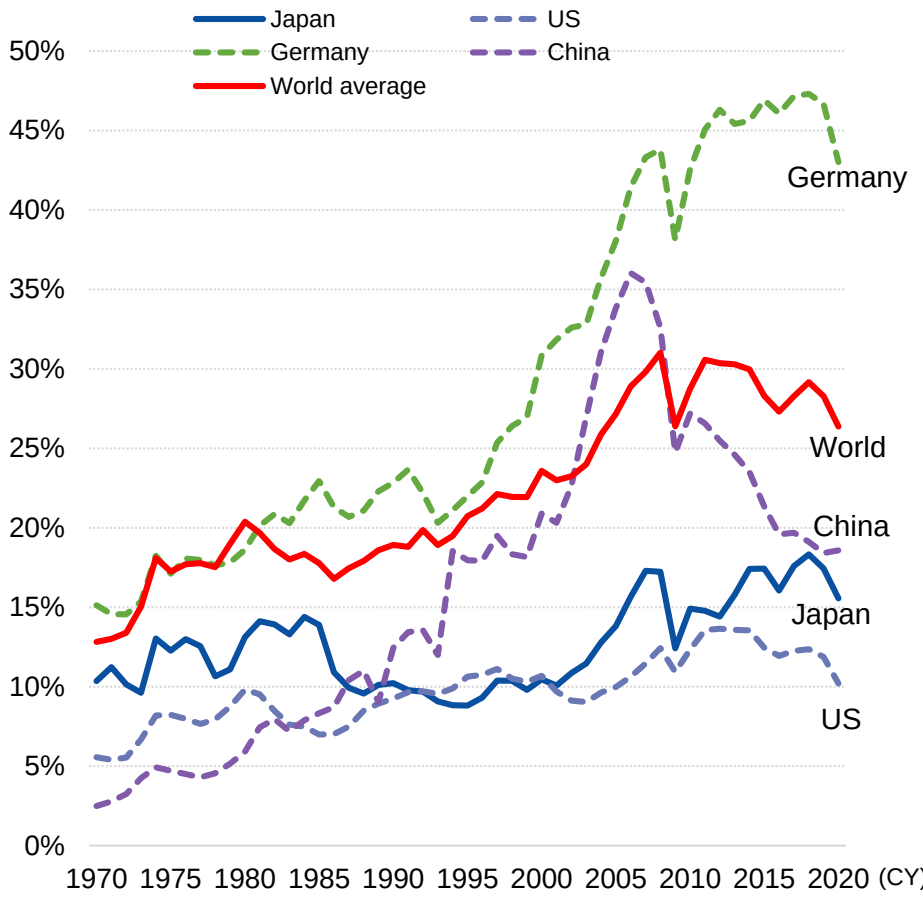
First time in approx. 100 years since the 1950s

Source: Compiled by Mizuho Bank Industry Research Department based on National Institute of Population and Social Security Research materials and *The Path to 2075 Slower Global Growth, But Convergence Remains Intact* by Goldman Sachs

Traditionally, Japan's growth has been driven by expanding domestic demand due to population growth

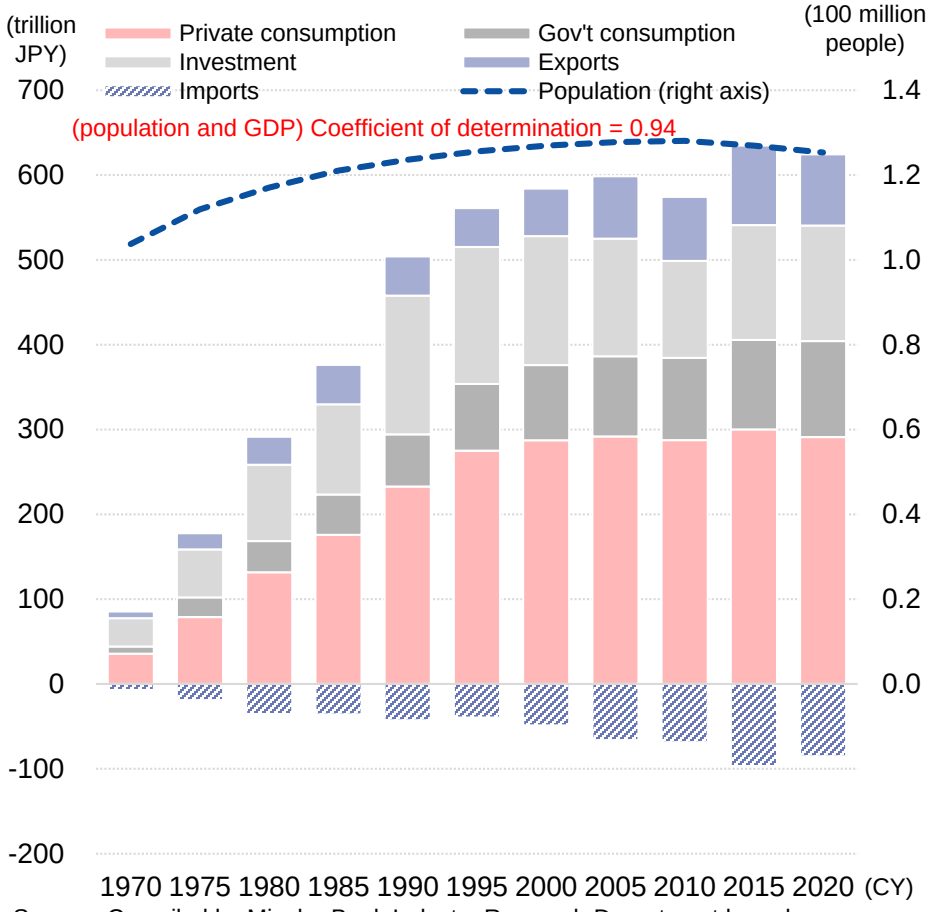
- It goes without saying that exports are important for Japan, but exports account for only a small percentage of nominal GDP, and private consumption due to population growth has significantly contributed to past economic growth.

Change in proportion of exports in nominal GDP (1970-2020)



Source: Compiled by Mizuho Bank Industry Research Department based on OECD.Stat

Japan's nominal GDP (expenditure side) and population trends (1970-2020)

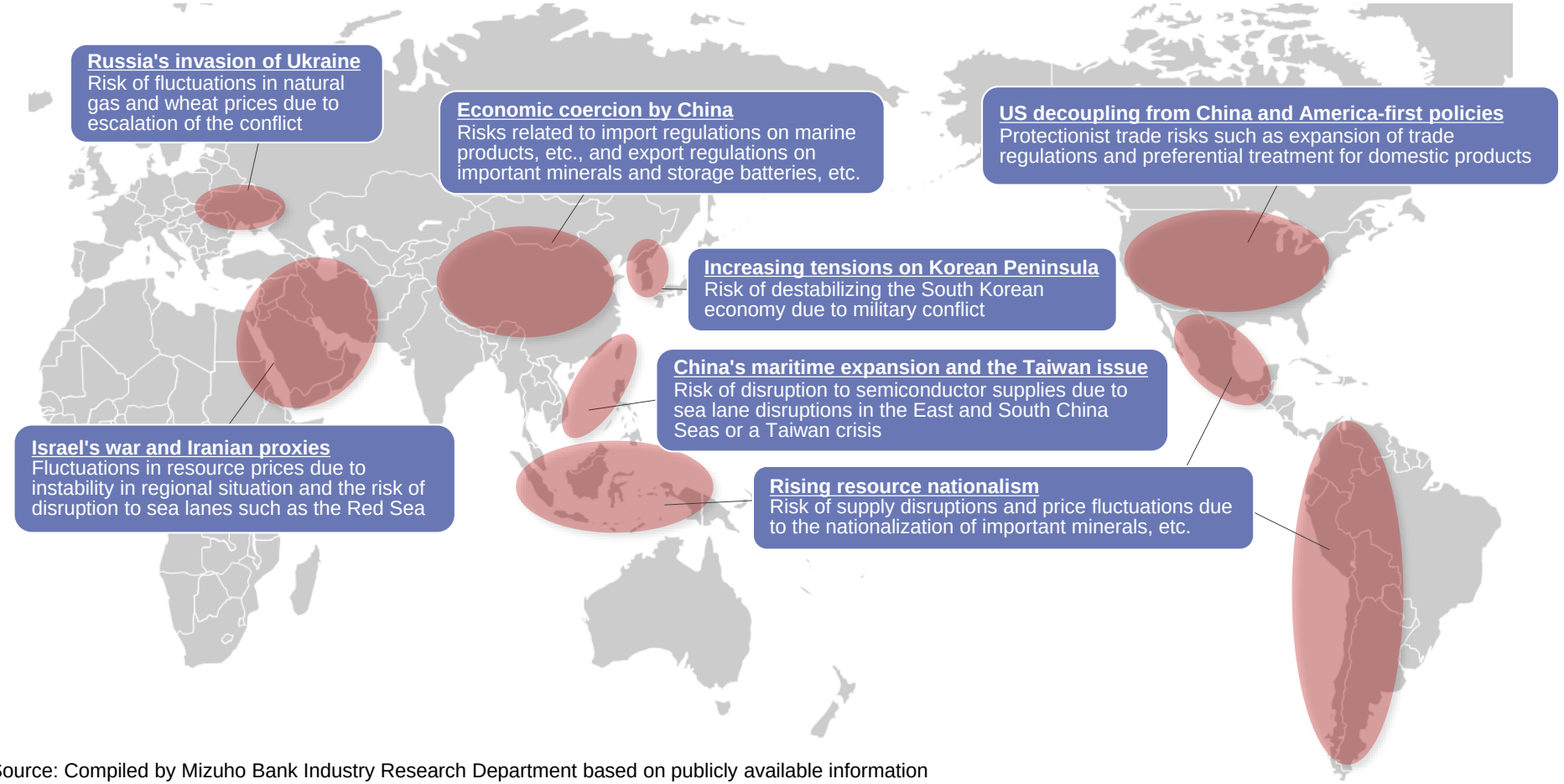


Source: Compiled by Mizuho Bank Industry Research Department based on OECD.Stat and National Institute of Population and Social Security Research materials

Economic security: Rising geopolitical risks

- The international community is becoming increasingly multipolar (nonpolar) due to the declining influence of the US, and turmoil is deepening as conflicts and confrontations are frequently occurring in various regions.
  - As a resource-poor maritime nation, Japan's economy is highly dependent on foreign trade, and there are concerns about impacts on industry and people's lives.

Major geopolitical risks around the world



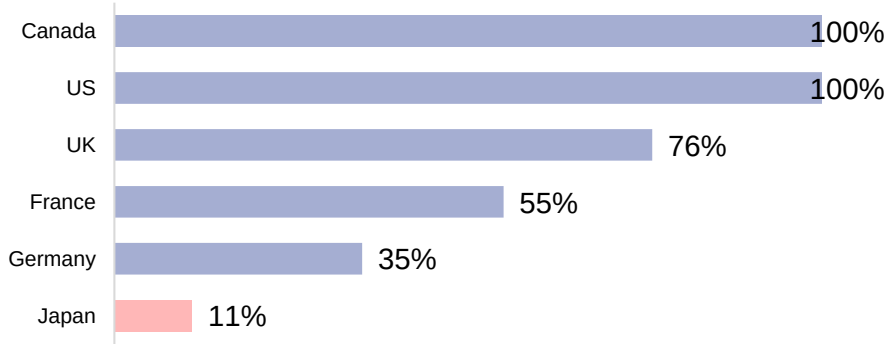
Source: Compiled by Mizuho Bank Industry Research Department based on publicly available information

Economic security: Japan's energy and food self-sufficiency rates are among the lowest in the developed world

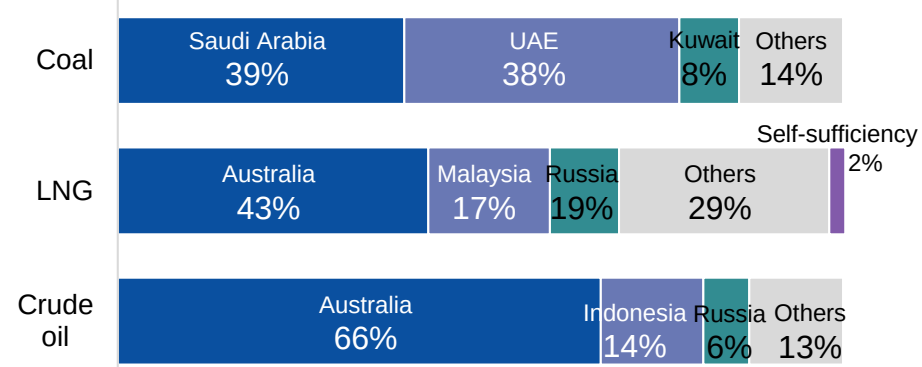
- Japan's self-sufficiency rates for energy and food, which are the basis for people's lives, are low, and there is the risk that Japan will lose out on being able to purchase during normal times and that it will be unable to purchase during emergencies.

Food self-sufficiency for G7 countries (over 100% is expressed as 100%)

Japan's energy self-sufficiency rate, which was around 20% before the Great East Japan Earthquake, has dropped significantly due to the shutdown of its nuclear power plants.



<Current situation in Japan (top imports, 2022)>

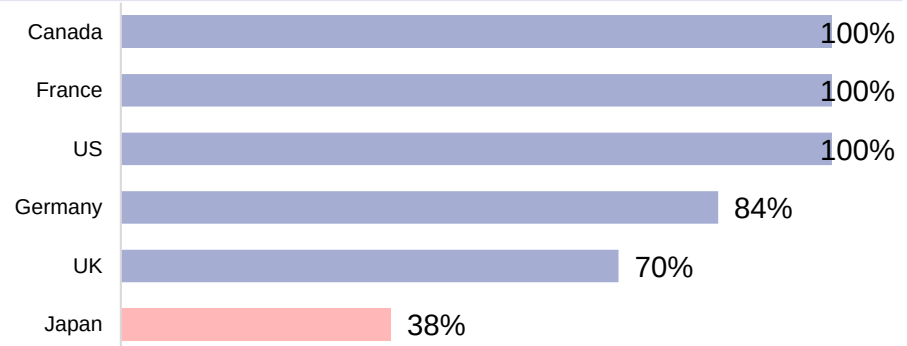


Note: Energy self-sufficiency rate is the FY2020 final value for Japan, and the estimated 2020 value for other countries

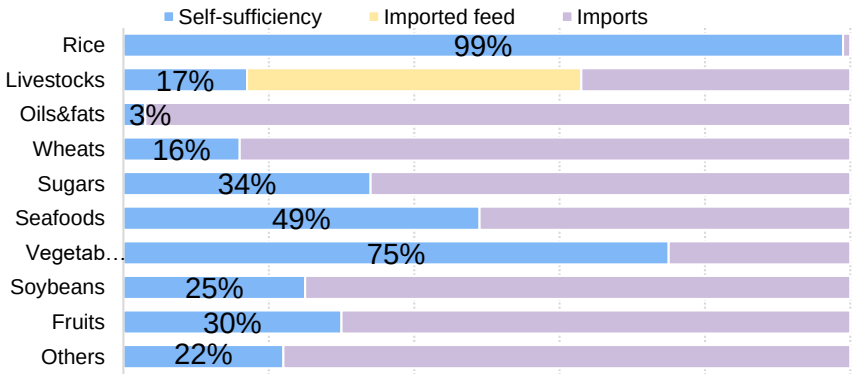
Source: Compiled by Mizuho Bank Industry Research Department based on Agency for Natural Resources and Energy materials

Food self-sufficiency for G7 countries (calorie basis, over 100% is expressed as 100%)

Japan's food self-sufficiency rate remains at just under 40% due to a decline in the consumption of rice, which has high calories per unit weight, and a shift in dietary habits towards meat and bread, which are highly dependent on imports.



<Current situation in Japan (calorie basis, 2022)>



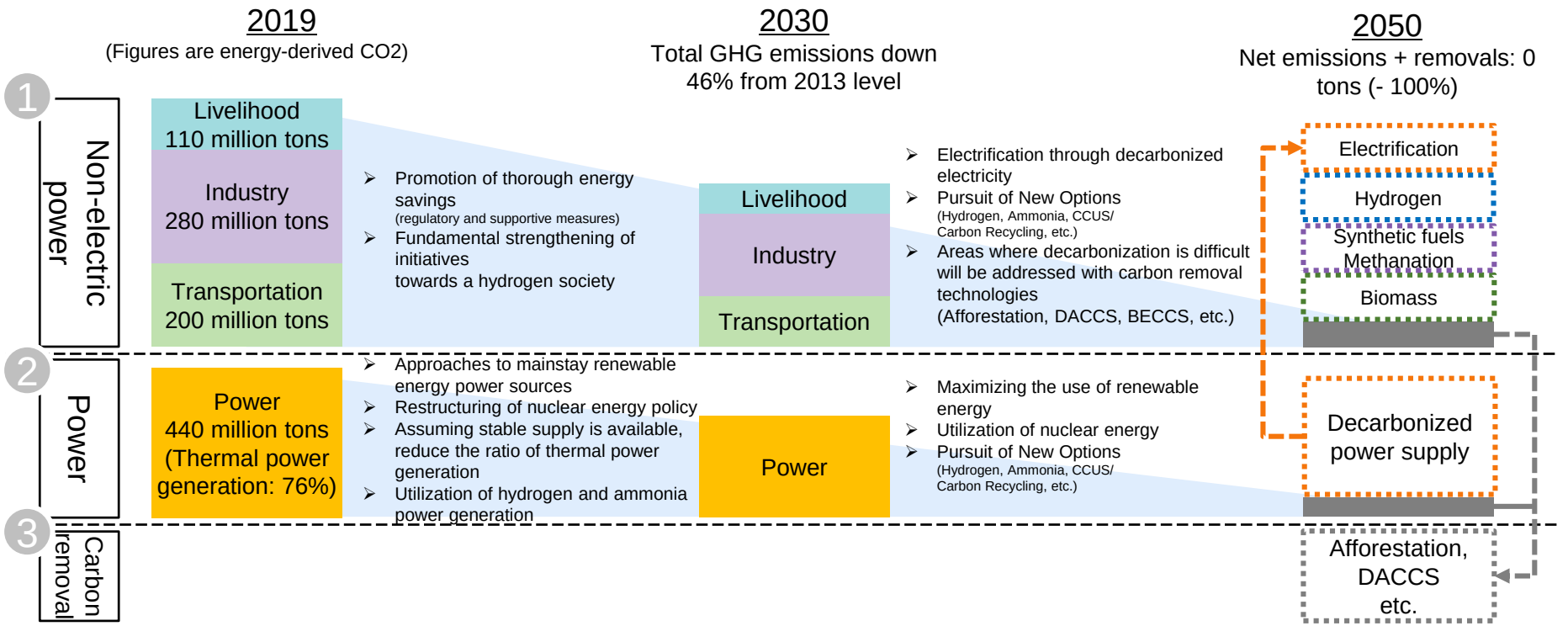
Note: Food self-sufficiency rate is the FY2022 value for Japan and the 2020 value for other countries. The value for the UK is based on production value.

Source: Compiled by Mizuho Bank Industry Research Department based on Ministry of Agriculture, Forestry and Fisheries materials

Energy: Advancement in electrification in all sectors based on the premise of decarbonization of power sources

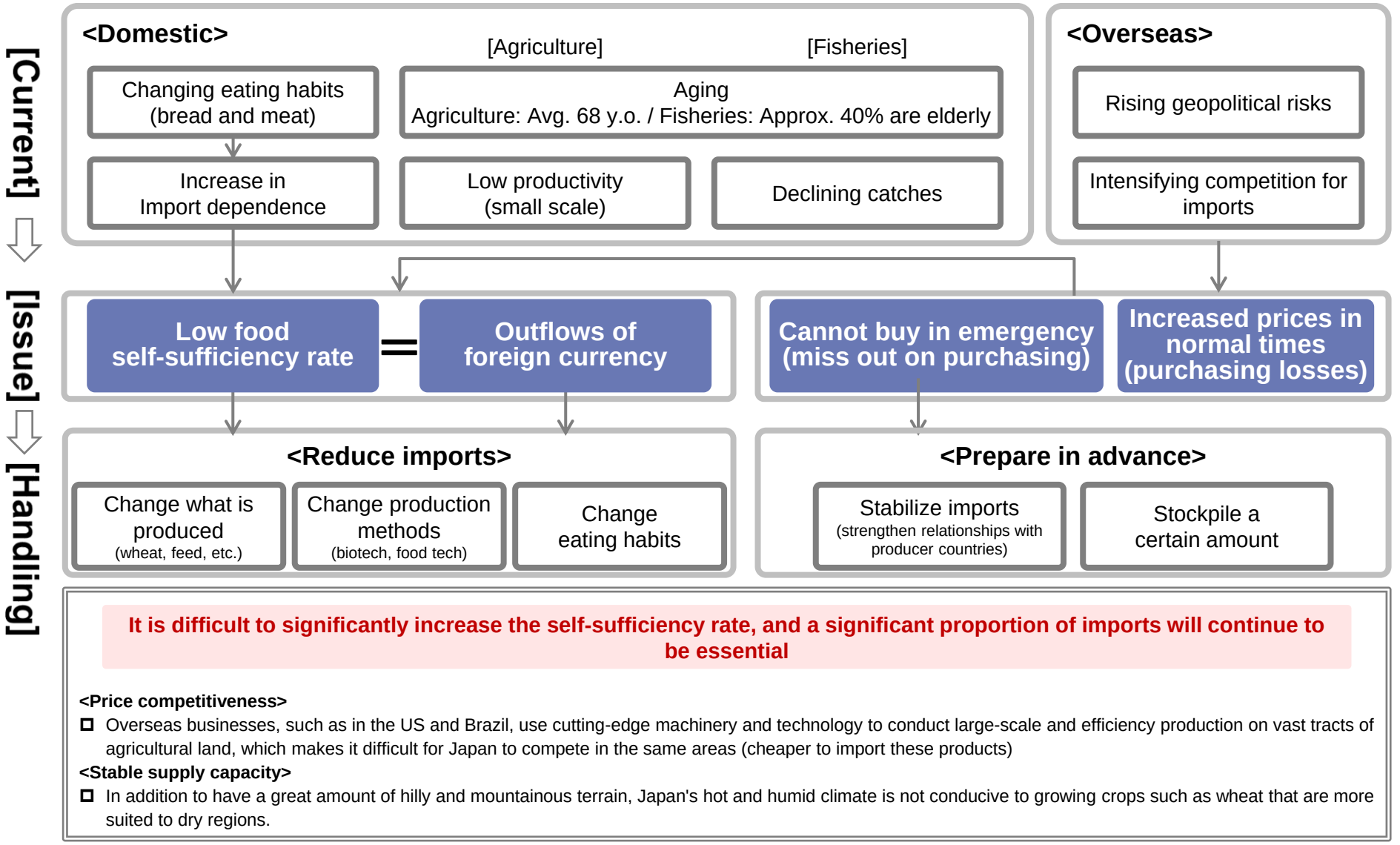
- To achieve carbon neutrality, it is important to: (1) reduce CO2 emissions from the non-electric power sector, (2) reduce CO2 emissions from the electric power sector, and (3) absorb/utilize CO2 emitted in areas where decarbonization is difficult.
  - In non-electric sectors, advancing electrification as much as possible allows for the procurement of decarbonized electricity, thereby reducing CO2 emissions. For areas that cannot be electrified, it will be necessary to utilize hydrogen, methanation, and synthetic fuels.
  - Decarbonization is a fundamental requirement for the power sector. This necessitates maximizing the use of renewable energy and nuclear power, in addition to reducing CO2 emissions from thermal power generation through the use of hydrogen and ammonia. Capturing, utilizing, and storing CO2 through CCUS and carbon recycling will also be essential.

Image of transition to carbon neutrality



Source: Compiled by Industry Research Department Mizuho Bank, Ltd. from the Agency for Natural Resources and Energy

Food: Possibility that an import-based worldview will not significantly change



It is difficult to significantly increase the self-sufficiency rate, and a significant proportion of imports will continue to be essential

<Price competitiveness>

- Overseas businesses, such as in the US and Brazil, use cutting-edge machinery and technology to conduct large-scale and efficiency production on vast tracts of agricultural land, which makes it difficult for Japan to compete in the same areas (cheaper to import these products)

<Stable supply capacity>

- In addition to have a great amount of hilly and mountainous terrain, Japan's hot and humid climate is not conducive to growing crops such as wheat that are more suited to dry regions.

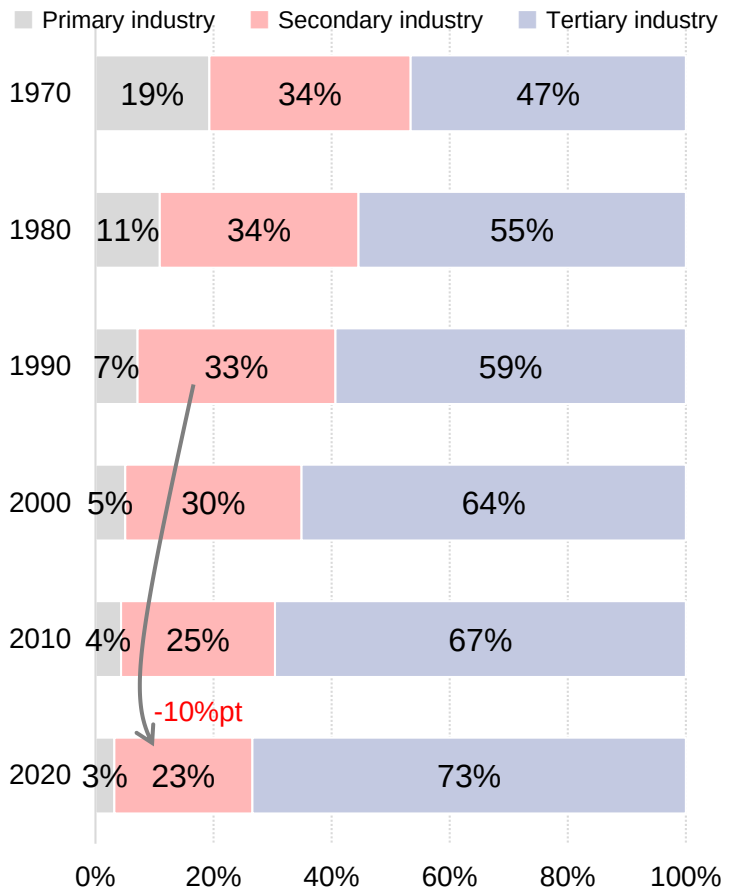
Source: Compiled by Mizuho Bank Industry Research Department

II. Reviewing Japanese Industry: Changing Trends Facing the Automobile Industry

Reviewing Japanese industry: Despite the shift to tertiary industries, *monozukuri* remains the foundation

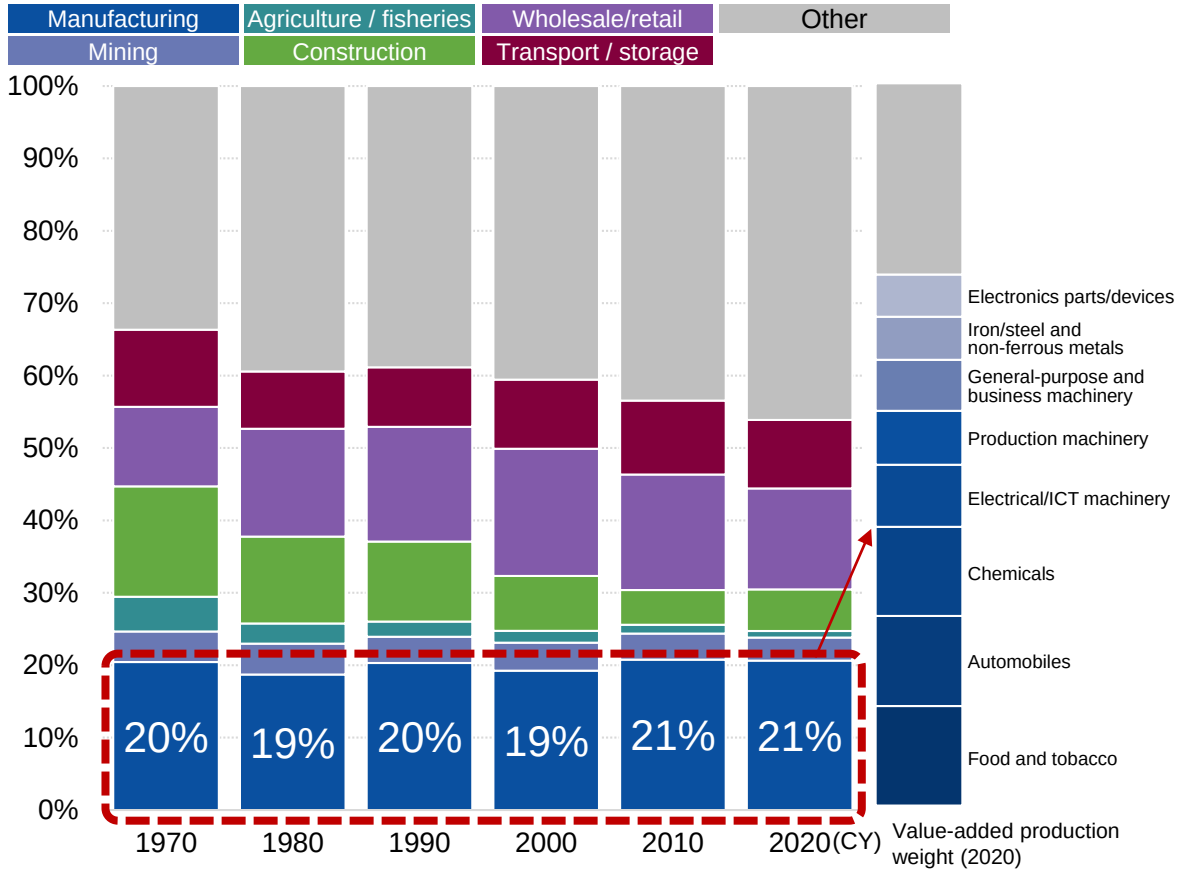
- In accordance with Petty-Clark's law, wherein economic development shifts from primary to secondary industries and then from secondary to tertiary industries, in Japan the weight of employment in the tertiary industry is gradually increasing, but the manufacturing industry remains at around 20% of GDP composition by industry.

Trends in composition ratio of employees by industry



Source: Compiled by Mizuho Bank Industry Research Department based on the Population Census by the Ministry of Internal Affairs and Communications

Trends in GDP composition ratio by industry, and value value-added production weight of industrial index



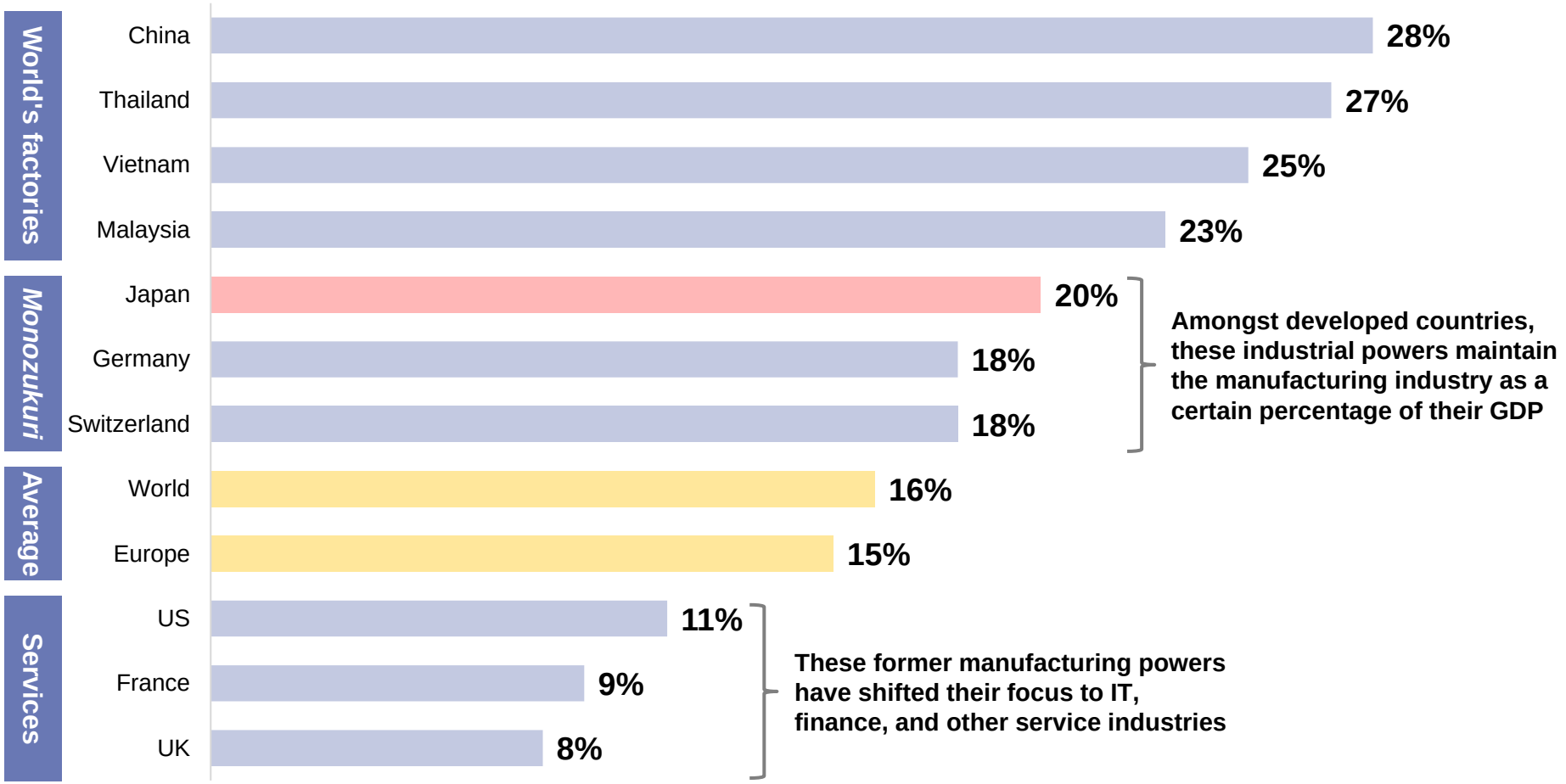
Note: The GDP composition ratio and the composition ratio of the industrial index do not have an equal relationship.

Source: Compiled by Mizuho Bank Industry Research Department based on OECD.Stat and the Indices of Industrial Production by the Ministry of Economy, Trade and Industry

Comparison with overseas countries/regions
Developed countries are divided into *monozukuri* and non-*monozukuri* countries

- Unlike the US and the UK, which have shifted from manufacturing to other industries, Japan, Germany, and Switzerland have traditionally been centered around industry and still have a high proportion of manufacturing industries.

Manufacturing industry as a percentage of GDP (2021)

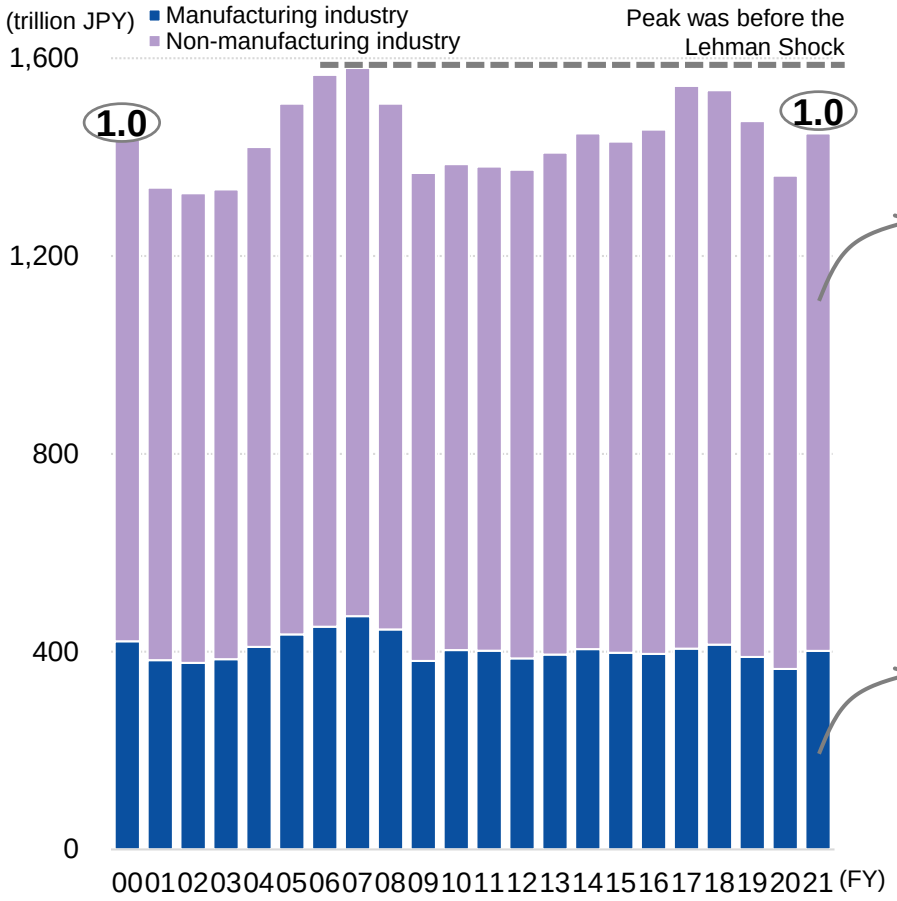


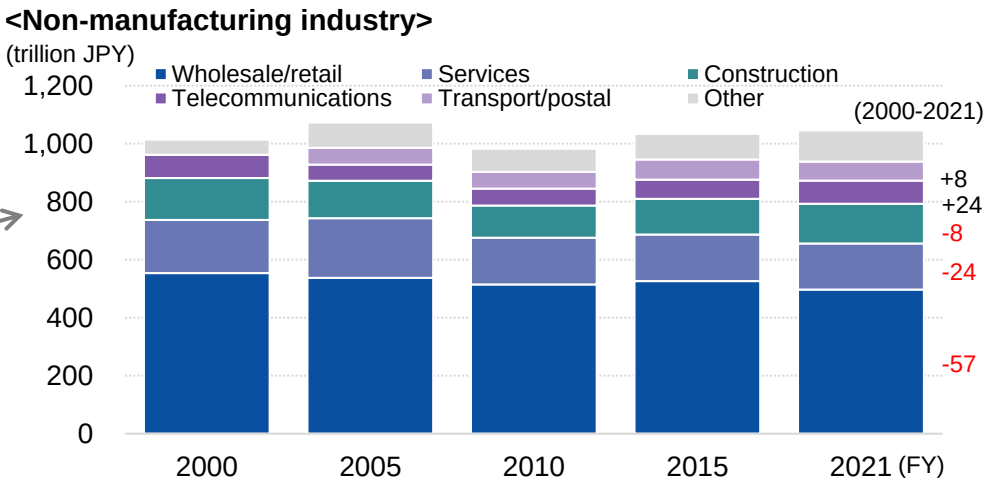
Source: Compiled by Mizuho Bank Industry Research Department based on World Bank materials

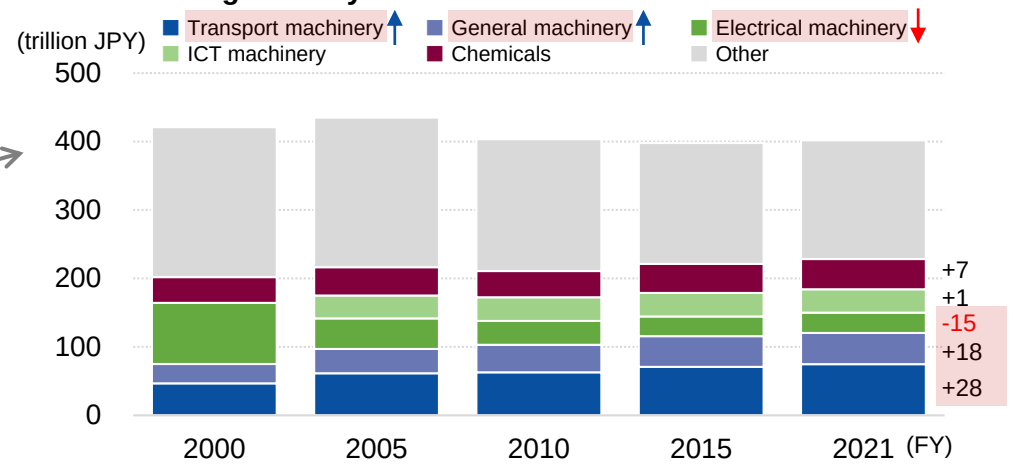
Reviewing Japanese industry: "Domestic" sales trends for Japanese companies

- The domestic sales of Japanese companies have remained flat after peaking before the Lehman Shock, although there are some fluctuations depending on the industry.

Trends in domestic sales for Japanese companies (FY2000-2021)







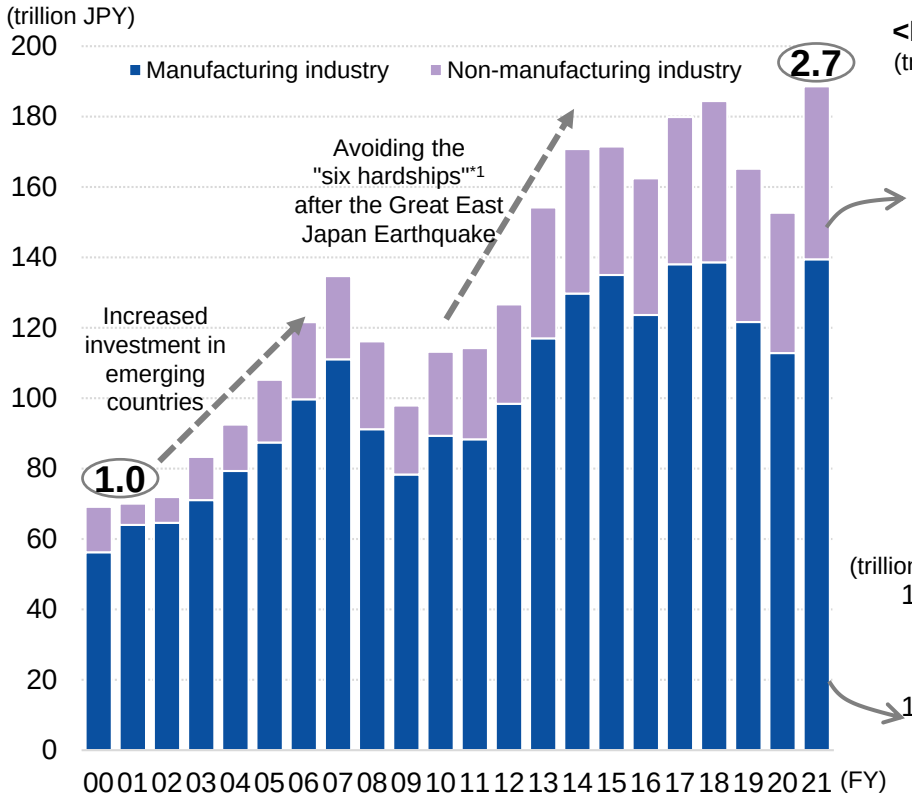
Note: Telecommunications, transport/postal, electrical machinery, and ICT machinery are compared to 2005. Others are compared to 2000.
Source: Both figures were compiled by Mizuho Bank Industry Research Department based on the Surveys for the Financial Statements Statistics of Corporations by the Ministry of Finance

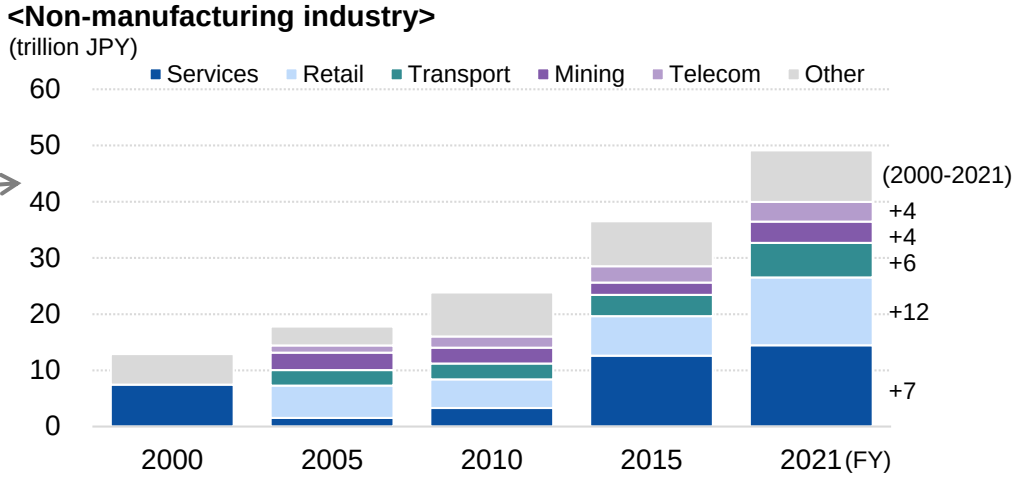
Note: General machinery from 2010 to 2021 is the total of commercial, production, and general-purpose machinery

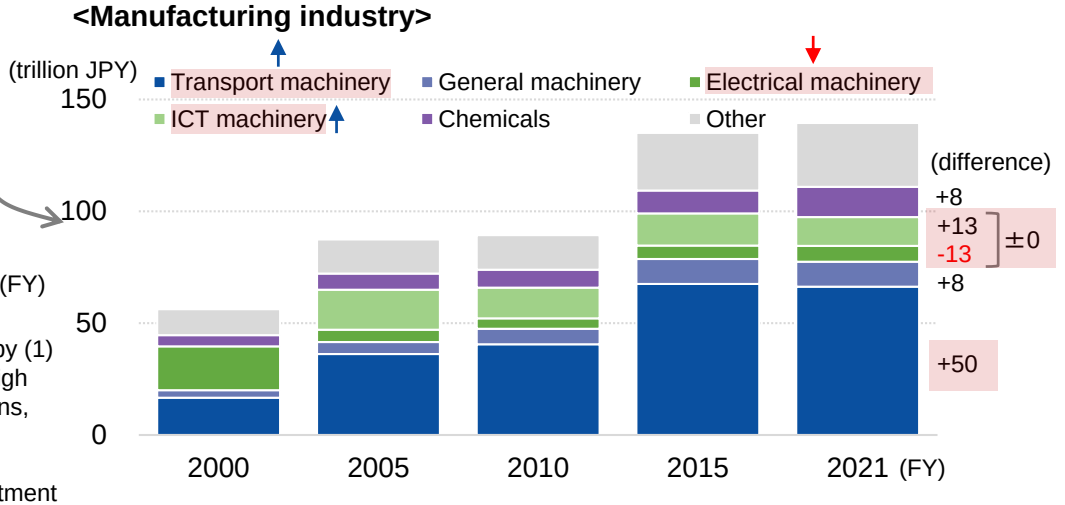
Reviewing Japanese industry: "Overseas" sales trends for Japanese companies (excl. wholesale)

- There has been significant sales growth from overseas subsidiaries in the manufacturing industry, centered around transportation equipment and automobiles in particular, accounting for nearly half of total manufacturing industry sales.

Trends in sales by Japanese companies' overseas subsidiaries (FY2000-2021, excl. wholesale)







*Note 1: The "six major hardships" is a Japanese expression that refers to the extremely difficult business environment at the time that was caused by (1) the strong yen, (2) delays in economic partnership agreements, (3) high corporate taxes, (4) labor market rigidity, (5) environmental regulations, and (6) power shortages and high power costs.

Note: FY2000 excludes commerce, and FY2000-2021 excludes wholesale

Source: Both figures were compiled by Mizuho Bank Industry Research Department based on the Basic Survey on Overseas Business Activities by the Ministry of Economy, Trade and Industry

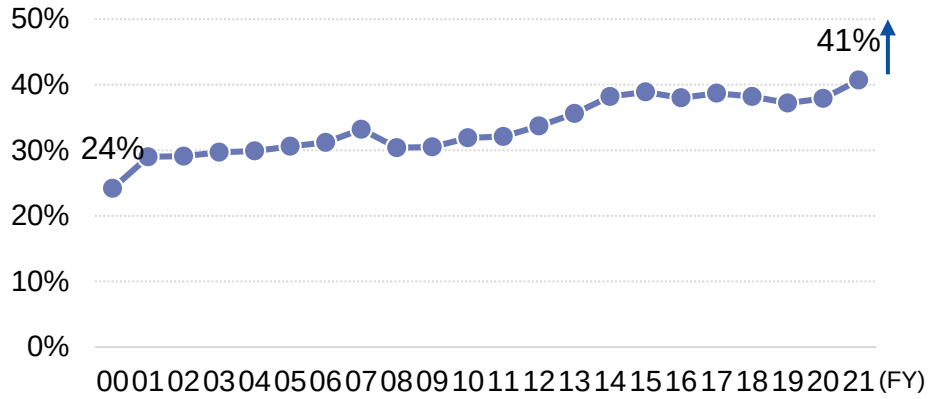
Note: Services, transport machinery, general machinery, and chemicals are compared to 2000. Others are compared to 2005.

Reviewing Japanese industry: Japanese companies' overseas businesses: State of production/procurement and research/development

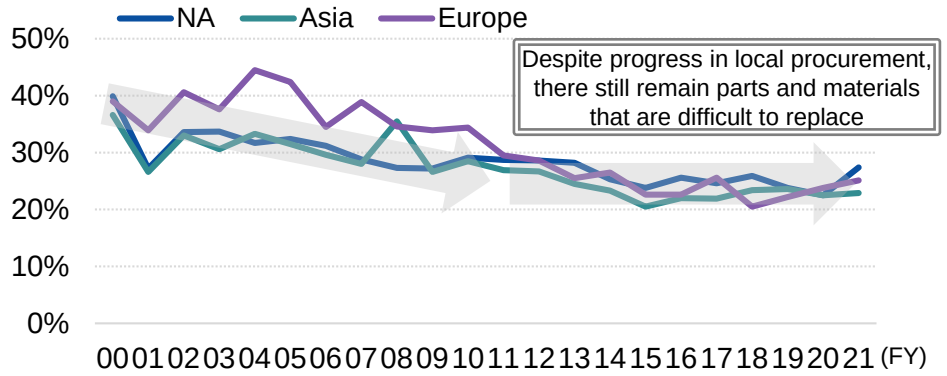
- Japanese companies are strengthening their overseas operations to acquire cheap labor and develop local markets, with the overseas production ratio climbing to more than 40%.
- In order to meet local needs, overseas research and development expenses are also increasing, with Japanese companies' research and development expenses expected to reach a total of JPY 1 trillion.

Overseas production and procurement status

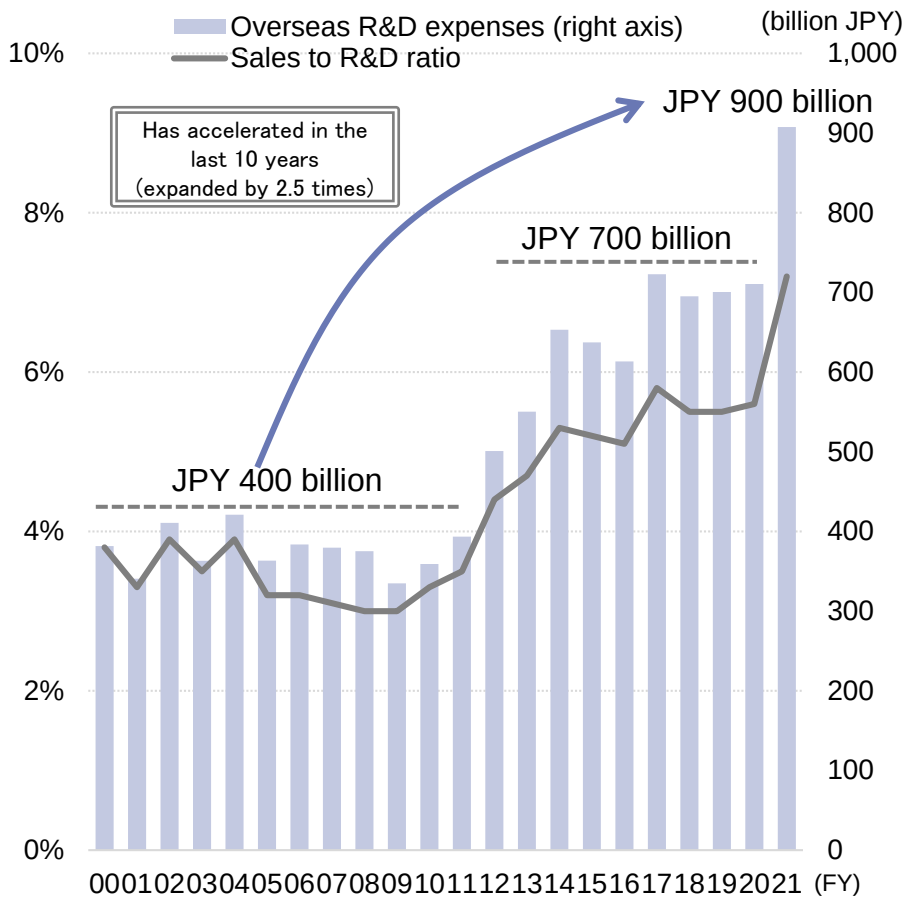
<Changes in Japanese companies' overseas production ratio*>



<Ratio of overseas subsidiaries (of Japanese companies) procuring from Japan>



Overseas research and development status



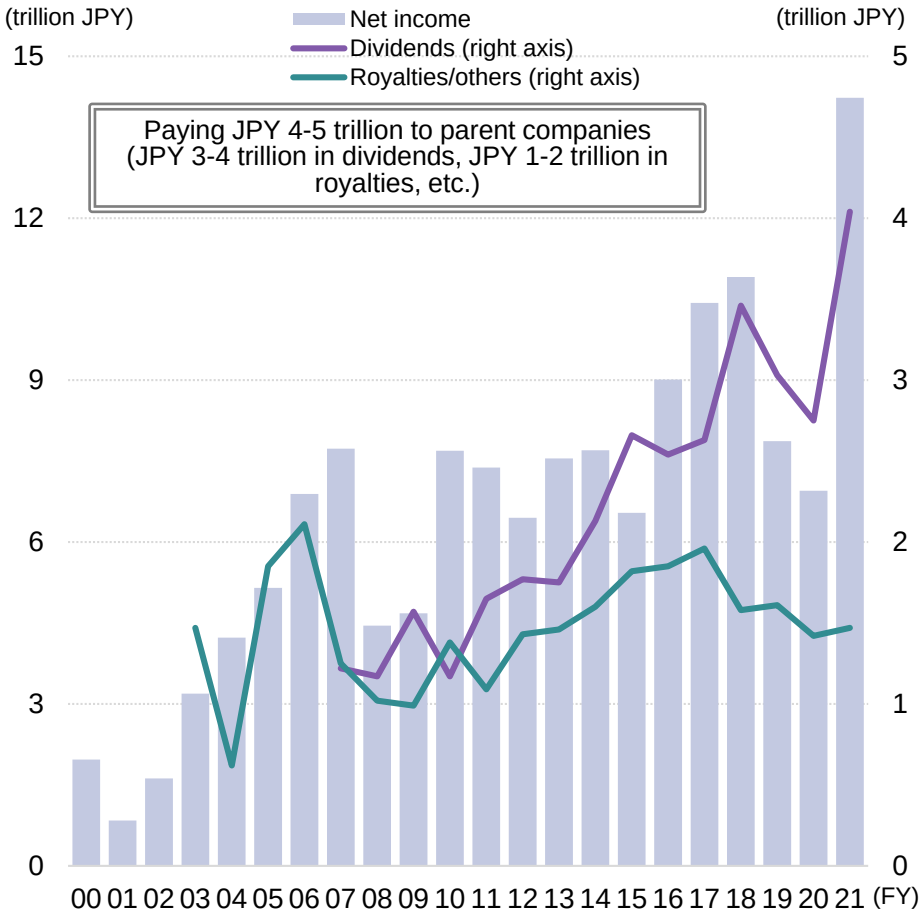
Note: Based on companies expanding overseas

Source: Both figures were compiled by Mizuho Bank Industry Research Department based on the Basic Survey on Overseas Business Activities by the Ministry of Economy, Trade and Industry

Reviewing Japanese industry: Japanese companies' overseas businesses: Returning earned cash back to Japan

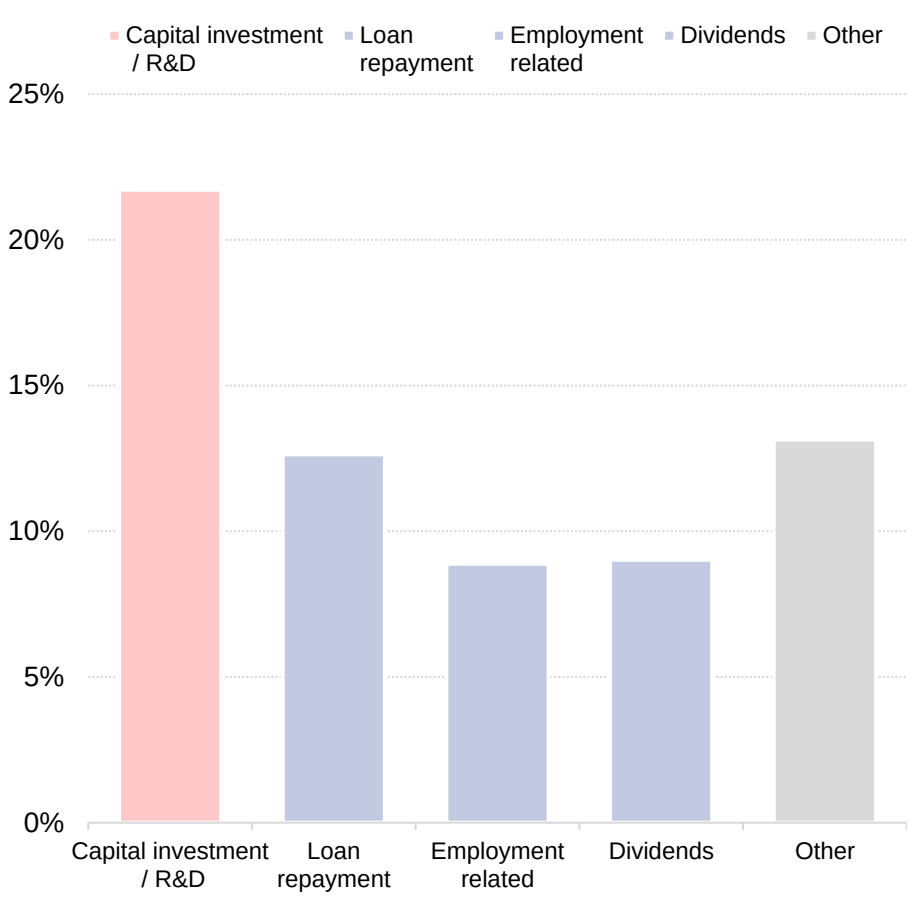
- Japanese companies' overseas subsidiaries return 30 to 40% of their net income to Japanese investors, such as the parent company, which then allocates the dividends to capital investment and research and development expenses, etc.

Trends in payments from overseas subsidiaries to Japanese investors



Source: Both figures were compiled by Mizuho Bank Industry Research Department based on the Basic Survey on Overseas Business Activities by the Ministry of Economy, Trade and Industry

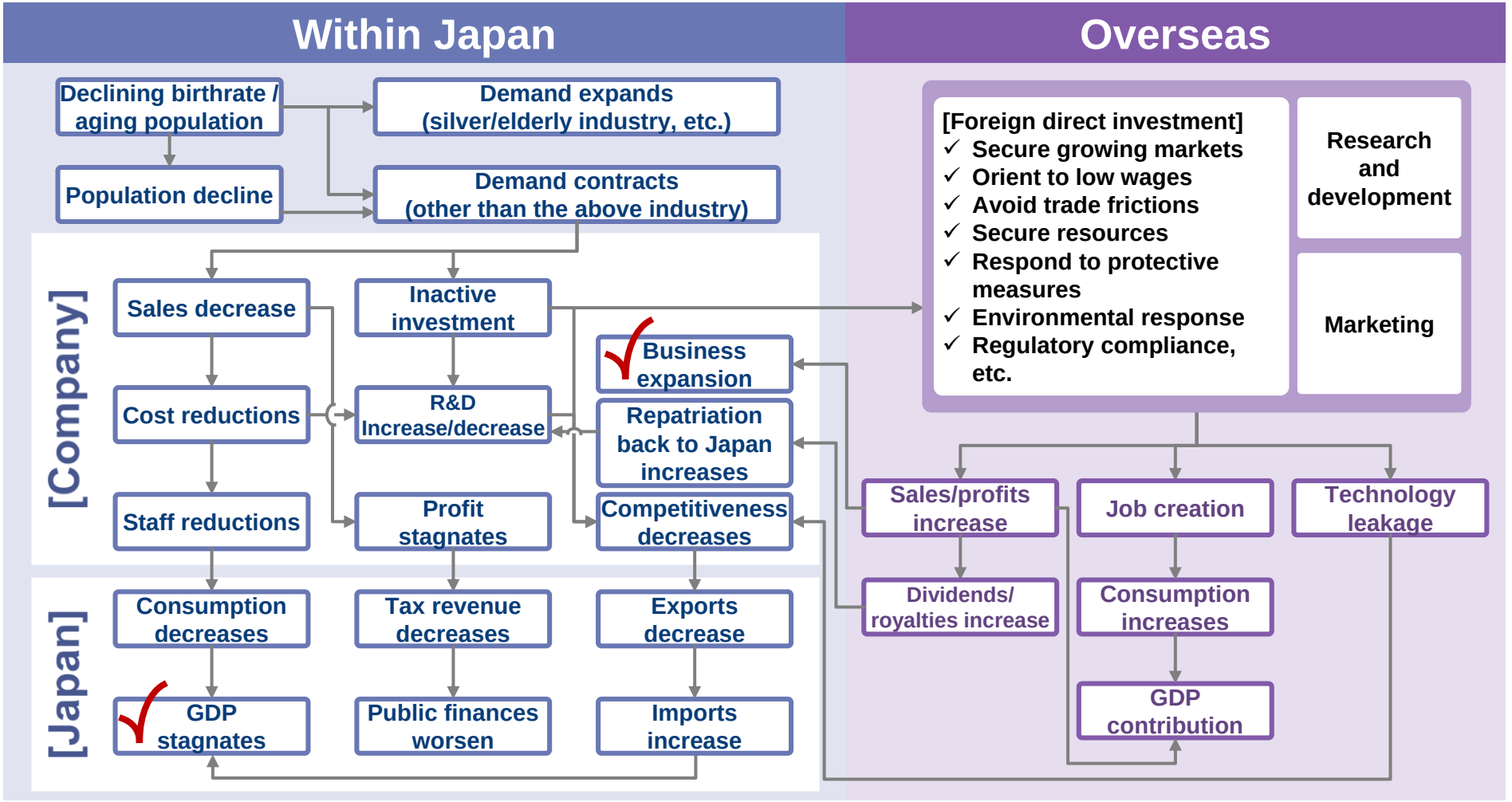
Use of dividends from overseas subsidiaries



Note: Values are averages from FY2012-2016, and cover medium- to long-term (multiple answer possible)

Reviewing Japanese industry: Growth of companies and of Japan/industry do not necessarily match

- The actions of Japanese companies aiming for sustainable growth by expanding their overseas businesses lead to a decline in capital investment and consumption within Japan, and, in some cases, are contrary to Japan's economic development.



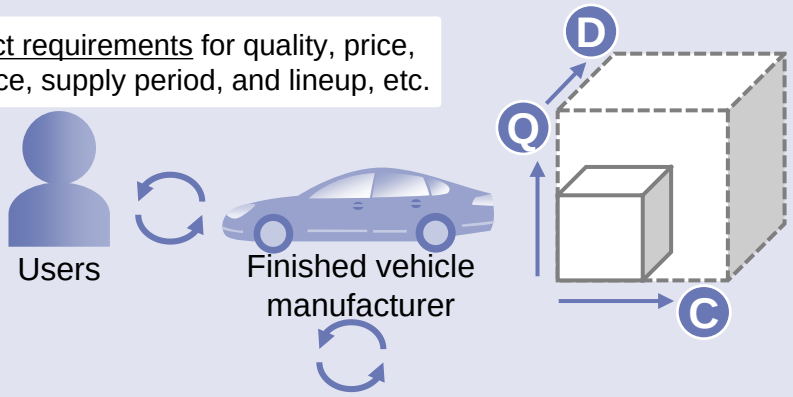
Source: Compiled by Mizuho Bank Industry Research Department

The automobile industry has driven Japan's manufacturing industry: Contributing to the development of industry and technology

1 [Within Japan: Automobiles]

Thoroughly improve QCD*, including both automobiles and peripheral industries

Strict requirements for quality, price, service, supply period, and lineup, etc.



Industrial/technological clusters

	[Parts]	[Machinery]	[Materials]
Industry	Automobile parts	Machine tools	Chemicals
Industry	Electronics	Robots	Iron and steel
Technology	Metal / resin processing	Welding / painting	Quality management
Technology	Electronics	Dies / molds	Inspections

2 [Overseas: Automobiles]

In regions where Japanese finished vehicle manufacturers are strong, upstream industries are also involved and have established a presence

- Capturing overseas markets using QCD established in the Japanese market as a weapon
- High share in NA, ASEAN, and Indian markets, and a certain presence in China and other countries
- Generally speaking, in regions where Japanese finished vehicle manufacturers are strong, their suppliers have also established a business base and expanded their business

3 [Within Japan and Overseas: Other Industries]

Taking technologies and products refined in the automobile industry and transferring them to other industries

Track record of meeting various required characteristics (such as safety, durability, environmental characteristics, reliability, and comfort) can also be utilized in other industries

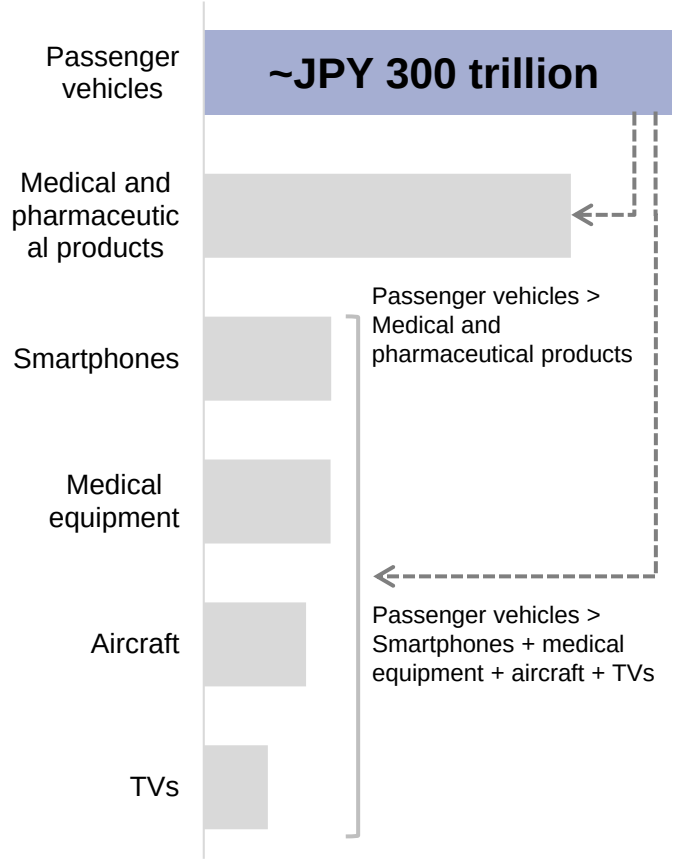
Home appliances	Electronics	Aircraft	Space	Railroads
Healthcare	Energy	Construction	Agriculture	Food

Note: QCD is an abbreviation for Quality, Cost, and Delivery
Source: Compiled by Mizuho Bank Industry Research Department

The automobile industry has driven Japan's manufacturing industry: Contributing to other industries via both quantity and quality

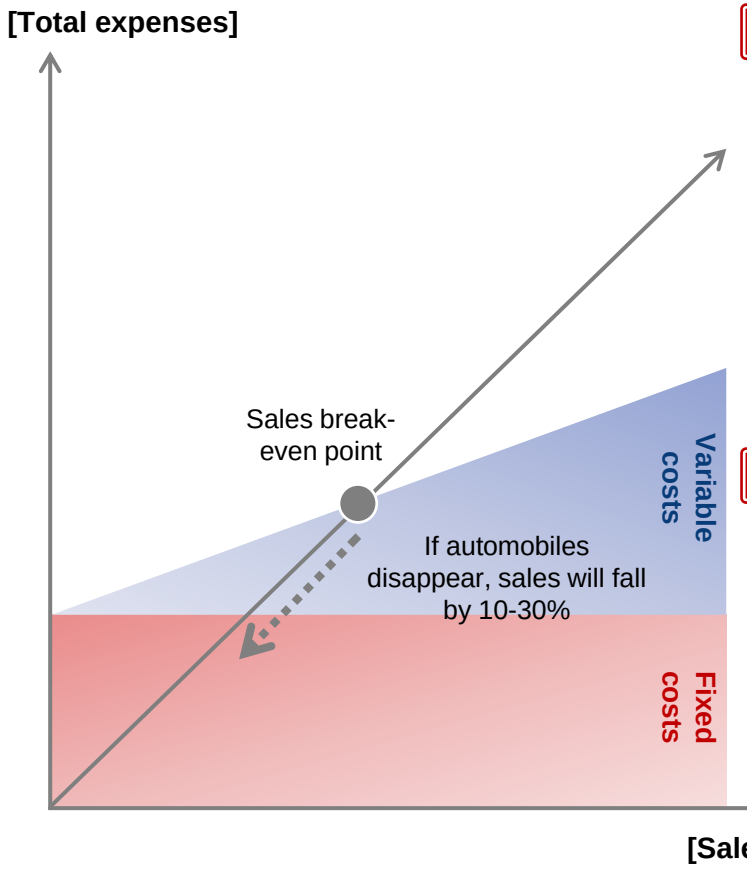
- The automobile industry is by far Japan's largest end product market. It goes without saying that the impact of the automobile industry itself is large, but it is also important for peripheral businesses (such as parts, materials, and machinery / equipment) in terms of covering fixed costs and conducting research and development.

Comparison of global market size of various industries (image)



Note: Calculated at 1 USD = JPY 150
Source: Compiled by Mizuho Bank Industry Research Department based on publicly available information

What the automobile market's size means for suppliers



Contributing to quantity

- It varies by industry, but, for example, automobiles account for 10-30% of sales for materials, machine tools, and industrial robots
- Although profitability is limited in many cases, sales for automobiles are used to cover fixed costs
- Automobiles exceed other end products in terms of volume and have a large impact on factory operating rates

Contributing to quality

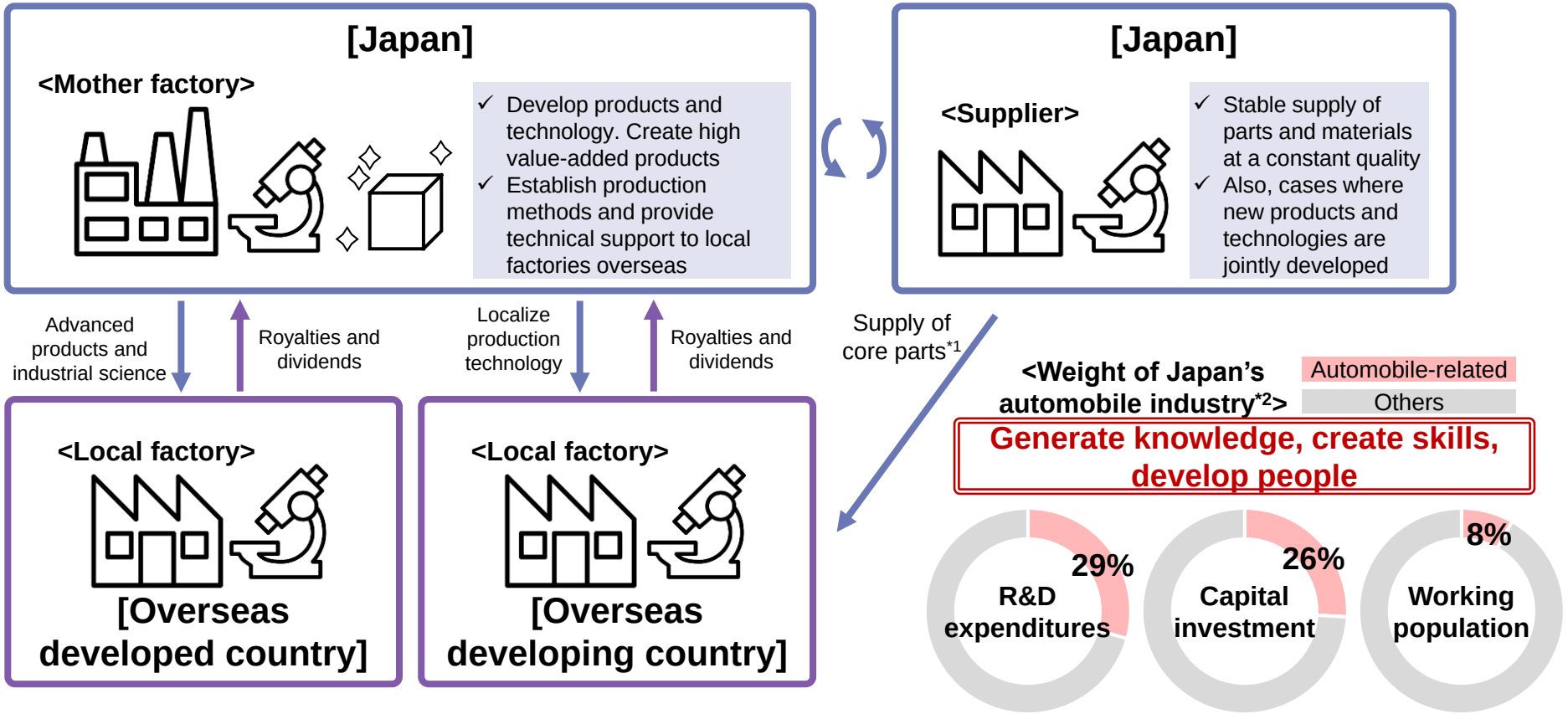
- Research and development expenses are generally set in proportion to sales, so business scale is the source of sowing seeds for the next generation
- Sales for automobiles support the manufacturing of general-purpose products, and the by-products are used as raw materials for functional products (e.g. chemicals)

Source: Compiled by Mizuho Bank Industry Research Department

The automobile industry has driven Japan's manufacturing industry: The core of Japan's *monozukuri*

- The automobile industry accounts for more than a quarter of the research and development expenditures of Japan's entire manufacturing industry. Its presence can be called the core of Japan's *monozukuri*, and it has established a strong presence by creating products that are competitive domestically and then expanding them to overseas countries.

The winning strategy of Japan's manufacturing industry: The mother factory and R&D work together to create added value and then expand overseas



Note 1: Parts and materials that are difficult to procure locally are procured from Japan. Accounts for approx. 30% of total procurement amounts
Note 2: FY2021 results
Source: Compiled by Mizuho Bank Industry Research Department based on Japan Automobile Manufacturers Association materials

Changes in the automobile industry: Automobile characteristics and the strengths of the Japanese automobile industry

Characteristics of automobiles as "things"

Extremely high entry barriers (technology + regulations)

- Must comply with strict safety standards and environmental regulations that vary by country/region
- Human life is involved, so extremely high safety and durability standards are required
- The large number of parts necessitates complex supply chains and production processes
- Requires enormous initial investments and long development periods, so takes time to recover investment
- Achieving high fuel efficiency and driving performance requires complex and advanced control technologies
- Maintenance requires specialized skills and qualifications

High-value, differentiated finished product

- Essential product as a means of transportation in daily life
- Product whose widespread use has become a symbol of social affluence and economic development
- Branded products whose ownership itself is a value and status symbol
- Luxury goods for enjoying driving and leisure, etc.
- Expensive, durable consumer good with long replacement cycles
- There is a wide variety of product variations, and clear differences between brands and models

Strengths of the Japanese automobile industry

Business model

Vertically integrated supply chains

- ✓ Strong pyramid structure within a product series
- ✓ Acquire cost control

Enclosed value chains

- ✓ Construction of strong dealer networks
- ✓ Acquire price control

Craftsmanship / tacit knowledge

Excellent production technologies

- ✓ Mass production and supply of quality and moderately-priced products
- ✓ Continuous cost reductions

Constant *kaizen* activities

- ✓ Thorough *tsukurikomi** and the pursuit of perfection
- ✓ Continuous and incremental performance improvements

Japan's automobile industry has succeeded in differentiating its finished products, and has established a strong global presence by having both cost control and price control

- While promoting local production for local consumption, the Japanese automobile industry is maintaining an enormous industrial base, including suppliers and peripheral industries, and creating large amounts of trade income and domestic employment
- Because of the huge production assets and the heavy burden from capital investment and advanced development, the profit margins for manufacturing and sales are thin, and the structure is supplemented by highly profitable sales financing and after-sales services
- By thoroughly utilizing existing assets and making steady efforts to reduce costs and improve functionality, the Japanese automobile industry is able to launch competitive products and overcome increasingly stringent regulations

Note: *Tsukurikomi* is a Japanese term for the process of incorporating material quality and processing techniques during the manufacturing process to achieve a desired result.
Source: Compiled by Mizuho Bank Industry Research Department

Changes in the automobile industry: The future of mobility will be driven by changes in consumer needs and social structure

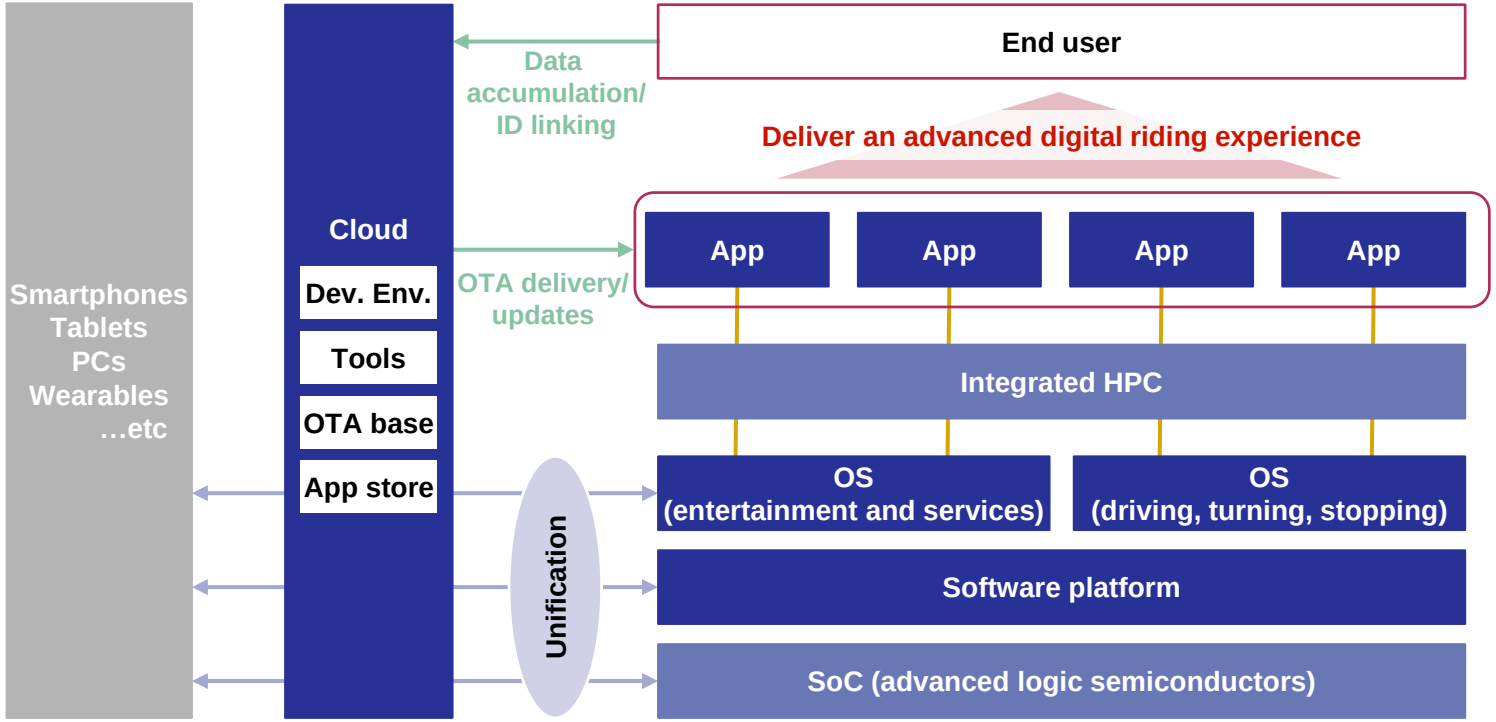
Changes in consumer needs		Changes in social structure	
Spread of subscriptions	■ Don't feel need to own, and prefer flat-rate unlimited use plans ■ Emphasis on service platforms' ease of use	Pressure to achieve carbon neutrality	■ Need to balance costs with optimal powertrain selection based on LCA ■ Restrictions on private car ownership may be inevitable
Emphasis on experiences, not functions	■ Emphasis on "the experience gained by combining features" rather than on individual features ■ Preference for integrated, simple, and frictionless UI (no instructions required)	Stricter safety standards	■ Increasing social pressure for zero automobile fatalities ■ Strict focus on the safety of autonomous driving systems
Emphasis on individuality and time performance	■ Emphasis on being different from others, on being yourself, and on keeping up with trends ■ Rapid increase in speed/quantity of content consumption, and shortened shelf life	National prioritization and economic security	■ Industrial, environmental, energy, and security policy being combined ■ Advances in supply chains, data enclosure, and blocking
Community-based consumption	■ Expansion of the fan economy and supporting my fave activities consumption ■ Emphasis on reputation, reviews, and sense of unity in communities	Decline of the middle class	■ Widening disparities due to the decline of industrial societies based on manufacturing ■ Increase in lean and efficient consumption behavior that emphasizes cost performance
Ethical consumption	■ Increasing consumer awareness of social contributions and of participating in solving problems ■ Increase in consumer behaviors that are considerate of people, society, the region, and the environment	Changes in travel demand	■ Decreased demand for daily transportation due to the expansion of e-commerce and the metaverse (increase in goods/things) ■ Possibility of transportation itself will stop being a daily occurrence or that it will become leisure/entertainment
Fusion of the virtual and the real	■ Expanding demand for new services/content due to spread of xR ■ Change of consumption behavior as the metaverse become more sophisticated and immersion times become longer	Evolution and expansion of cities	■ Increase in smart cities and compact cities ■ Advances in the sophistication and efficiency of urban infrastructure such as transportation services

Mobility in 2050

Electrification and vehicle intelligence are inevitable (BEV and SDV at a level close to 100%)	**Progress on local production for local consumption of vehicles and core components, and on data export restrictions**	**Providing subscriptions for personalized service packages will become a core business**
Personal vehicles ownership will decrease, and service vehicles and dedicated MaaS vehicles (Level 4 self-driving cars) will increase	**Product lifecycle reductions and real-time improvements (supported by software updates and additions)**	**Progress on integrating automobiles and urban infrastructure (transportation and electricity, etc.)**
Advances in "spatial devicification" of cars and in use of xR technologies in exterior design	**The collection of data that is essential for developing and personalizing software and services will become a source of competitiveness**	**Vehicles themselves will become more standardized and uniform, and value of the finished product will decrease (changing into home appliances/terminals)**

Source: Compiled by Mizuho Bank Industry Research Department

Changes in the automobile industry: Electrification and vehicle intelligence are changing car architectures



Users will pay a premium for experiences, but not for functionality/performance

- ✓ Convert the entire riding experience, including "ride quality" and "driving performance," into digital content
- ✓ Integrate the car into the digital ecosystem, and position it as a device alongside smartphones, etc.
- ✓ "Fun to Drive" will also be considered a type of digital content and entertainment

Enormous R&D investments required for semiconductor and software design

- ✓ Must choose the best chip for the "riding experience" being offered
- ✓ Progress in vertical integration of chips, development environments, and software
- ✓ Outsourcing chips and software reduces the degree of freedom in product design

Maintain cost control + ensure basic performance and reliability

- ✓ Providing an outstanding "riding experience" requires a vehicle with high basic performance and reliability
- ✓ On the other hand, this in and of itself is not a source of added value, and cost reduction is the main competitive axis

Backyard

- ✓ **The backyard plays an essential role in improving the value of the "digital riding experience"**
- ✓ **Companies must aim to be cost leaders, as it is difficult for users to directly feel the "difference"**
- ✓ **On the other hand, enormous capital investment will be required**

Investment burden and costs must be reduced via sharing and standardization across OEMs

Source: Compiled by Mizuho Bank Industry Research Department

Changes in the business environment surrounding Japanese finished vehicle manufacturers: Risk of losing traditional strengths

Changes in the business environment surrounding Japanese finished vehicle manufacturers

Rise of Chinese OEMs
- They are rapidly expanding their share in China's NEV market by leveraging price competitiveness, vehicle intelligence, and development speed
- Their quality and brand power are also rapidly catching up
- Presence outside China is gradually expanding

Tesla's breakthrough
- Reigns at the top in terms of global BEV share and market capitalization
- Business model that emphasizes UX and post-vehicle sale
- In-house production of core technologies such as semiconductor design
- Has secured a premium based on brand power (high profitability)

New entry of IT/electronics companies
- Huawei and BAT are increasing their presence in the Chinese market
- Sony is entering the high value-added BEV business
- Rapid increase in adoption of AAOS and CarPlay
- Apple is rumored to be entering the BEV business

Concerns that the traditional strengths of Japanese manufacturers will become a legacy as new, nimble entrants emerge due to the lower barriers to entry and changes in competitive advantage

Oligopoly in battery cells
- Orders are concentrated on a small number of manufacturers that can stably supply high-quality battery cells
- With batteries accounting for 30-40% of BEV costs, cell manufactures are increasingly gaining control over costs

Semiconductors/software determine performance
- Increase of semiconductors' importance and quantities installed in everything from powertrain to chassis control, ADAS, and IVI
- Shift in vehicle control and flavor from mechanical to software
- Semiconductor vendors are increasing their presence

Platform commonality and gigacasting
- Consolidation into a limited number of dedicated BEV platforms is progressing, and in some cases the platforms straddle brands and OEMs
- Integral molding via gigacasting has made production processes simpler and more efficient (equipment industrialization)

Concerns that Japanese manufacturers' traditional strengths of *suriawase*, cost reductions, and *kaizen* will weaken and that there will be a relative decline in the value of production technologies

Profitability is deteriorating due to BEV shift
- Vehicle sales alone are not profitable; revenue per vehicle must be increased throughout its lifecycle
- Capex/R&D expenses are increasing, and at the same time existing assets are becoming legacy assets (difficult transition)

Blocking, as exemplified by US-China decoupling
- Major countries and regions are strengthening supply chain enclosures and using environmental policies and economic security as shields
- Regulation-driven local production for local consumption that is more attuned to "policy" than economic rationality will become inevitable

Aging and labor shortages at production sites
- Concerns that the "analog" strengths represented by TPS will not be maintained due to a lack of personnel
- Concerns that it will not be possible to maintain wide-ranging supply chains due to a lack of people to carry on businesses

Concerns that it will be difficult to earn foreign currency through conventional export of finished products and to maintain a domestic base of mother factors and places for producing advanced products

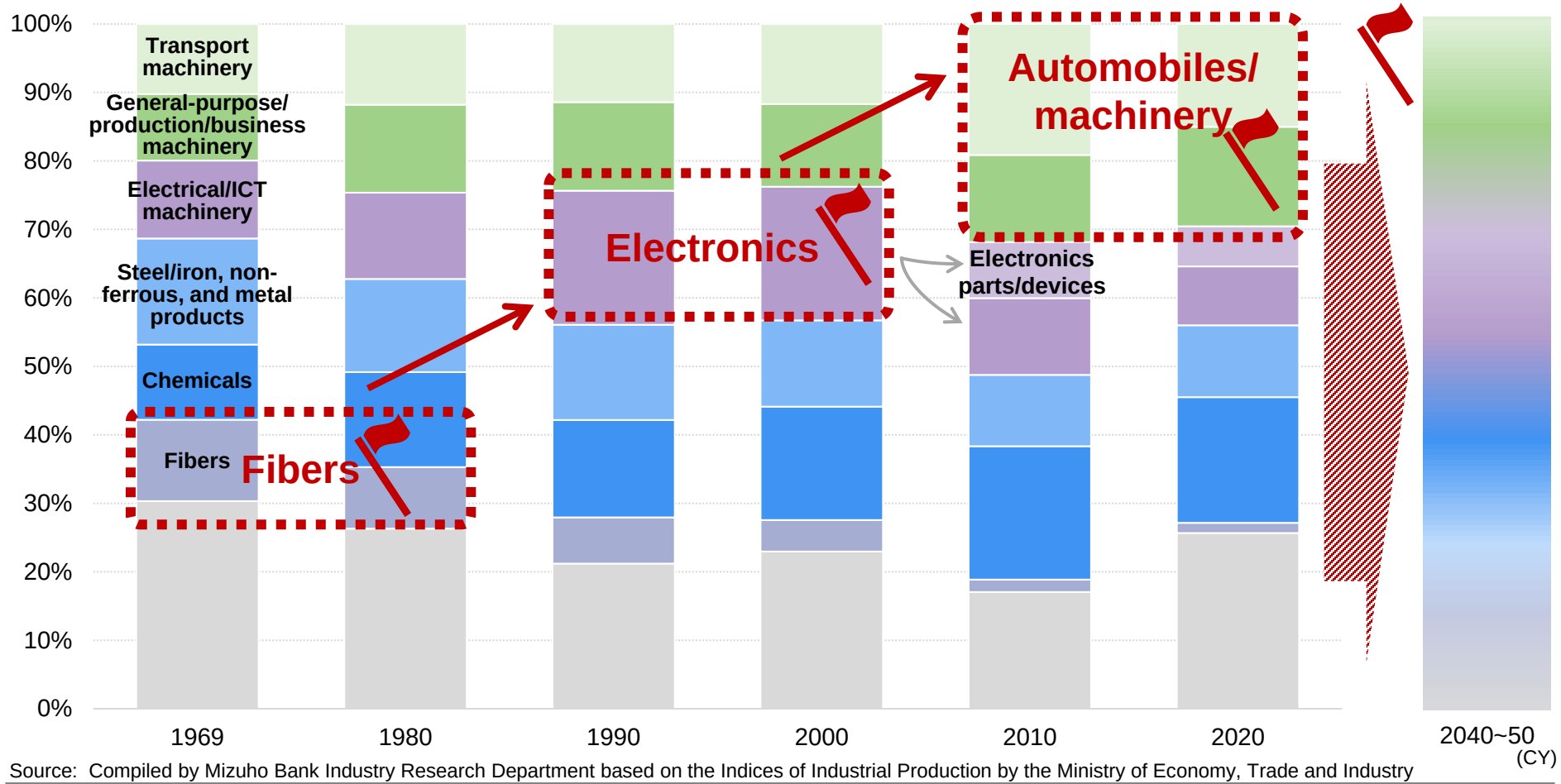
- **Currently, the competitive advantages of Japanese finished vehicle manufacturers are declining, and their presence in the automobile industry is also declining due to the rise of new entrants.**
- **In the long term, as structural changes in the automobile industry progress, the competitive environment will fundamentally change, and "competition within the automobile industry" will lose its meaning**

Source: Compiled by Mizuho Bank Industry Research Department

What will be the next flagship industry? Automobiles? Machinery? Electronics? Materials? Inbound?

- In the past, Japan's manufacturing industry had a history of catching up with the US and Europe, then kicking them out and achieving growth.
- In the future, attention will be focused on the next flagship that will drive Japan and Japanese industry, whether it comes from an existing industry or a new field.

Changes in industry weights in the industrial production index and trends in major production items



Source: Compiled by Mizuho Bank Industry Research Department based on the Indices of Industrial Production by the Ministry of Economy, Trade and Industry

III. Utilizing CPS: Towards Growth for Japan and Japanese Industry

Major issues facing Japan and Japanese industry: People: Labor productivity, labor shortages, and passing on skills

- In Japan, the population is shrinking due to the declining of birthrate and the aging of its society, so in recent years people-related issues (such as low labor productivity, labor shortages, and passing on skills) have become increasingly serious themes.

Major issues facing Japan and Japanese industry

1 Labor productivity	Manufacturing industry	☐ $92,000 added value per employee, which is 18th out of 35 major OECD member countries (2021) ☐ Japan was top amongst OECD countries in 2000, but fell to 9th place in 2005 and 2010, to 17th place in 2015, and since then has remained between 16th and 19th place
	Non-manufacturing industry	☐ Labor productivity growth rate in the service industry has been negative for the four consecutive years since FY2019 (backed by labor-intensive business structures where employment increases as business activities expand)
2 Labor shortages	Manufacturing industry	☐ When maintaining and expanding domestic production bases, 60% of manufacturers cited labor shortages as a key issue they hope the government will improve, including "securing factory workers" and "securing advanced engineers and skilled technicians"
	Non-manufacturing industry	☐ More than 70% of businesses in inns, hotels, and information services are short-staffed, and similarly, nearly 70% of businesses in the logistics and construction industries, which will be hit by the "2024 problem*", are already short-staffed
3 Passing on skills	Manufacturing industry	☐ Workplaces are having problems with passing on skills (by industry, 2018) －Manufacturing: 86.5%; medical care and welfare: 83.1%; lodging/food service: 82.6%, etc. ☐ More than 90% of businesses recognize that passing on skills is important (this is because the approx. 70% of businesses that do not think it is particularly important do not have any special technologies/skills to begin with) ☐ The most common initiative for passing on skills that is undertaken by companies is to have older employees continue working via rehiring or extended hours (approx. 70%), which is a so-called "ad hoc" solution
	Non-manufacturing industry	

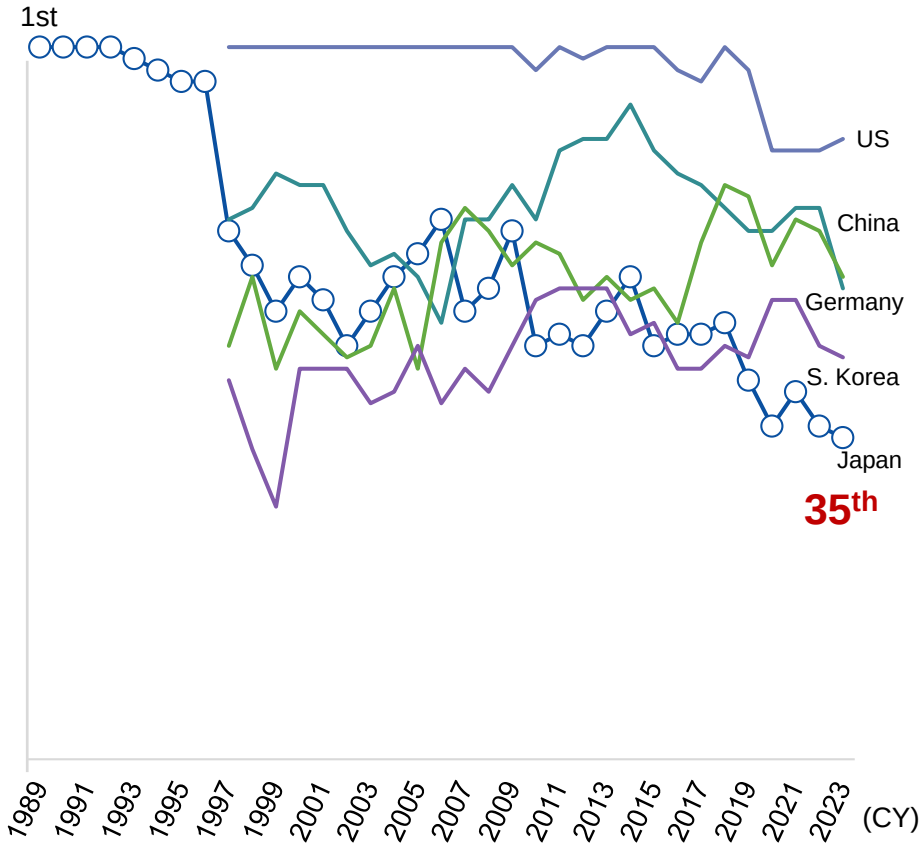
Note: The "2024 problem" refers to a regulatory change being enacted in April 2024 as part of the government's work-style reforms that will strictly limit truck drivers across Japan to an overtime cap of 960 hours per year.

Source: Compiled by Mizuho Bank Industry Research Department based on Japan Productivity Center; Ministry of Economy, Trade and Industry; Ministry of Health, Labour and Welfare; Teikoku Databank; and Japan Institute for Labour Policy and Training materials

The international competitiveness of Japan and Japanese industry: "Low efficiency" is a perennial issue

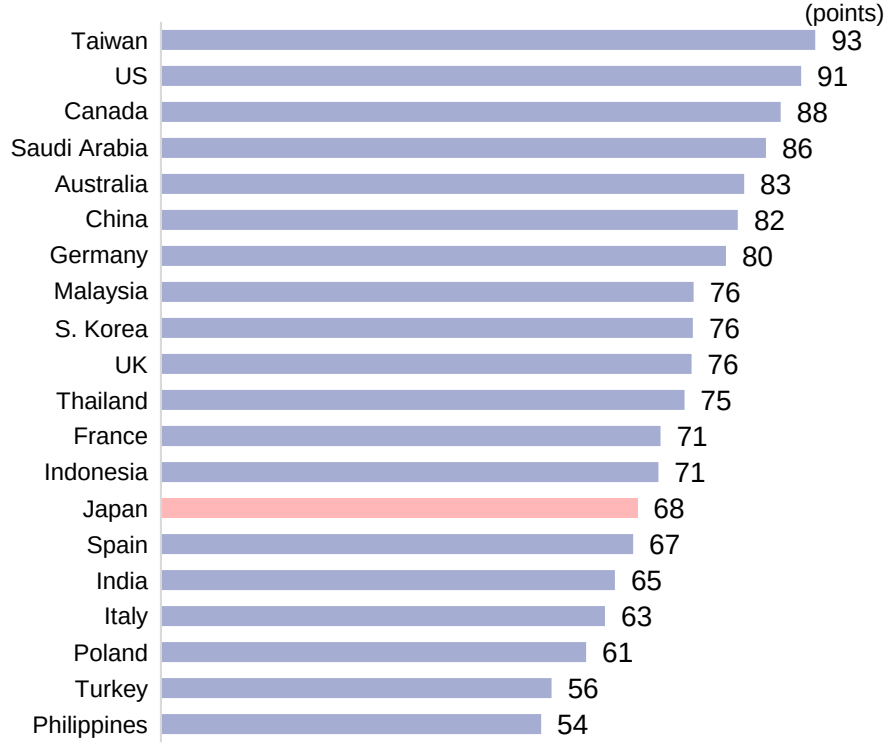
- According to the World Competitiveness Yearbook that is published annually by IMD (International Institute for Management Development), Japan's international competitiveness has been gradually declining (countries with small populations, such as Denmark and Switzerland, tend to rank high, but they are outperformed when compared to countries with populations of over 20 million.)

Changes in overall ranking according to the World Competitiveness Yearbook (1989-2023)



Source: Both figures were compiled by Mizuho Bank Industry Research Department based on the World Competitiveness Yearbook by the IMD

Ranking of countries with a population of 20 million or more (top 20 countries, 2023)



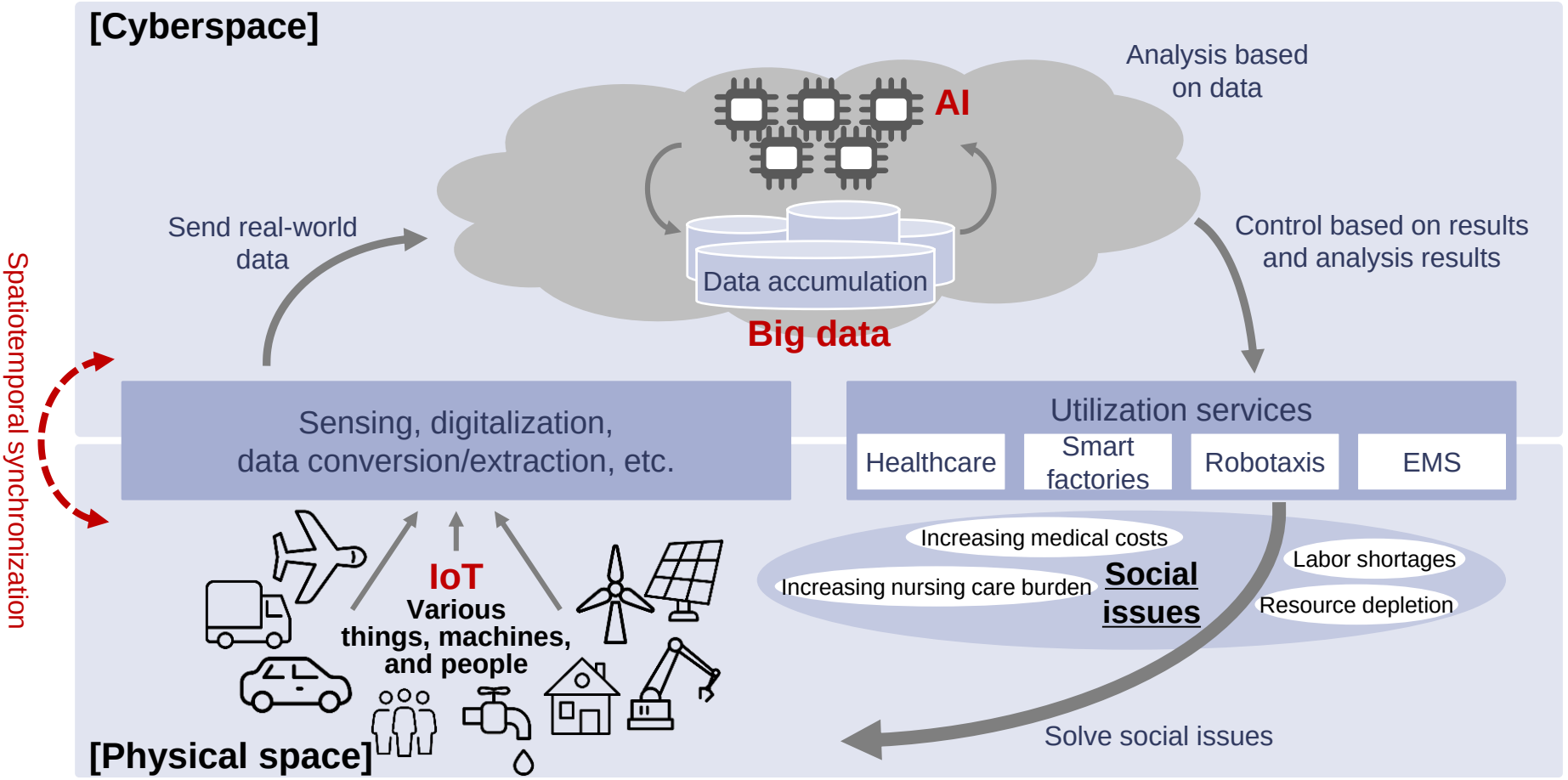
<Japan's ranking>

Economic performance	Government efficiency	Business efficiency	Infrastructure
26th	42nd	47th	23rd

The potential of CPS to solve labor productivity, labor shortages, and passing on skills

- By acquiring large amounts of data from physical spaces, analyzing it in cyberspace, and then utilizing it in real time in physical space, there is the possibility of transitioning from past analysis to future prediction, of turning tacit knowledge into explicit knowledge, and converting from partial optimization to overall optimization.

CPS conceptual diagram

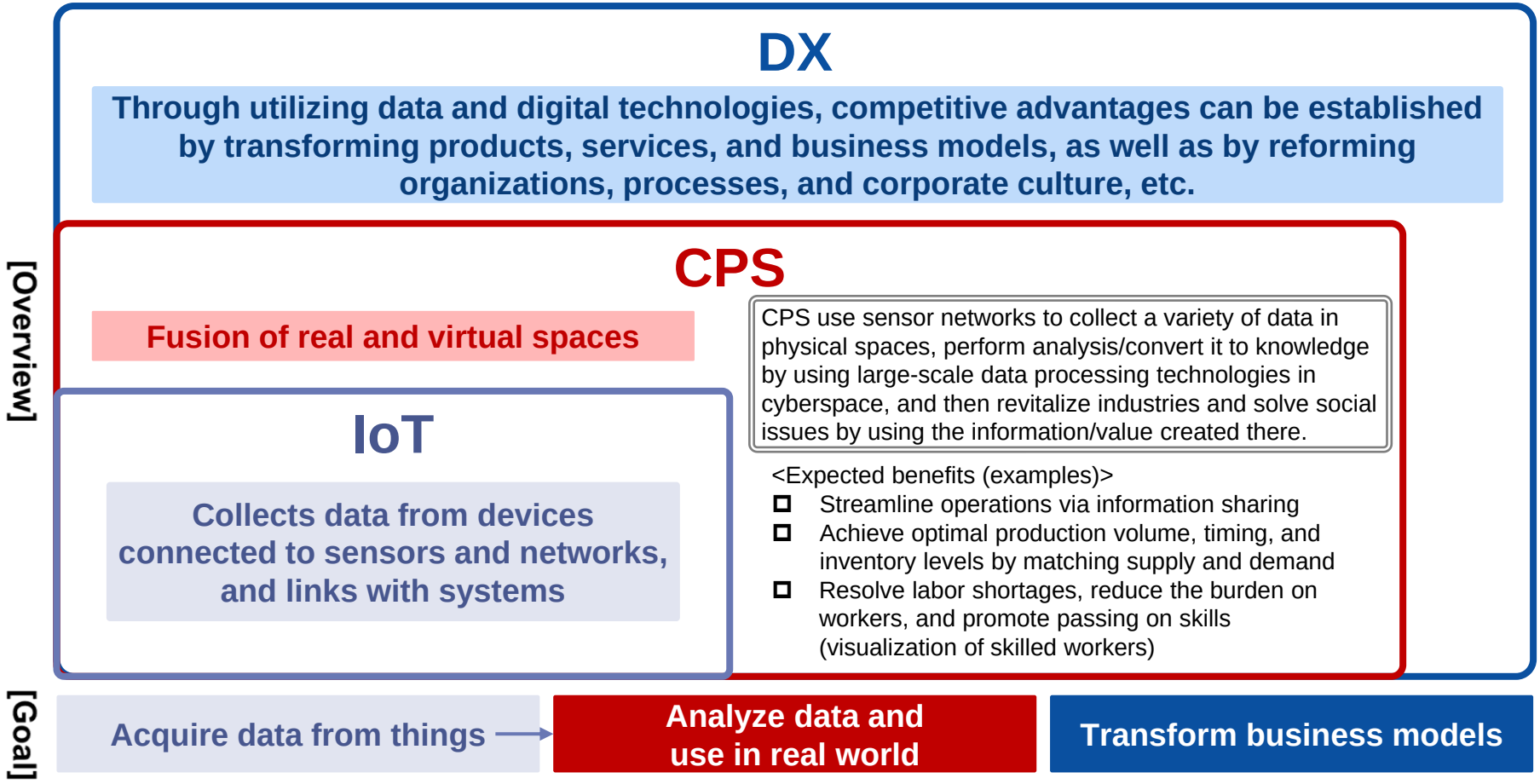


Source: Compiled by Mizuho Bank Industry Research Department based on the Ministry of Internal Affairs and Communications website

CPS overview: The relationship between CPS, IoT, and DX

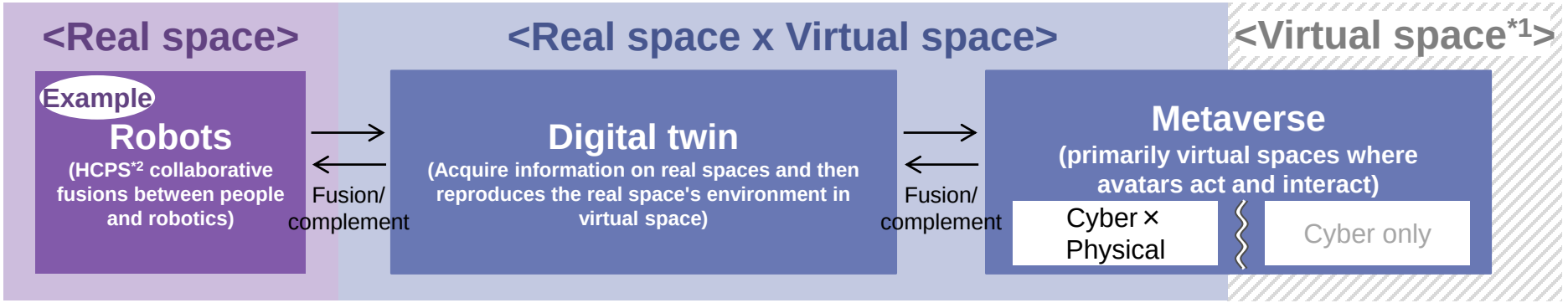
- Unlike DX, which refers to transforming business models through digital utilization, and IoT, which aims to acquire data, CPS aims to solve real-world problems based on the acquired data.

Definitions of and differences between CPS, IoT, and DX



Source: Compiled by Mizuho Bank Industry Research Department based on publicly available information

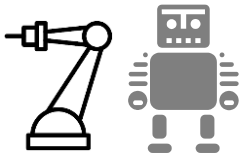
Effects brought about by CPS: Both defensive and offensive expectations



2. Strengthen work force
Possible to ensure quantity and quality

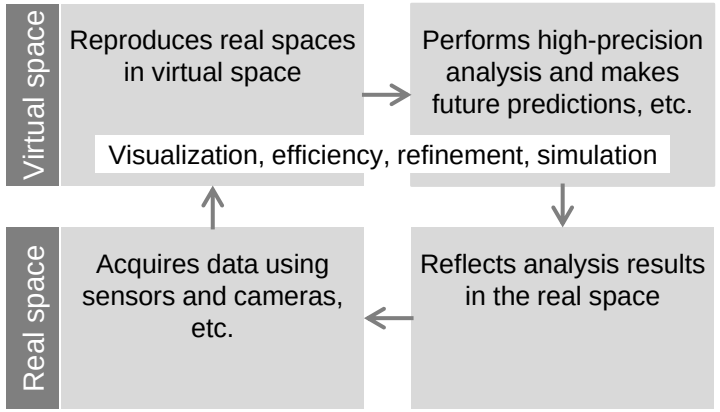
1. Improve production efficiency, pass on craftsmanship
Expected to improve both manufacturing and non-manufacturing industries

3. Create new sources of added value and income
UX (experiential value) becomes a differentiating factor

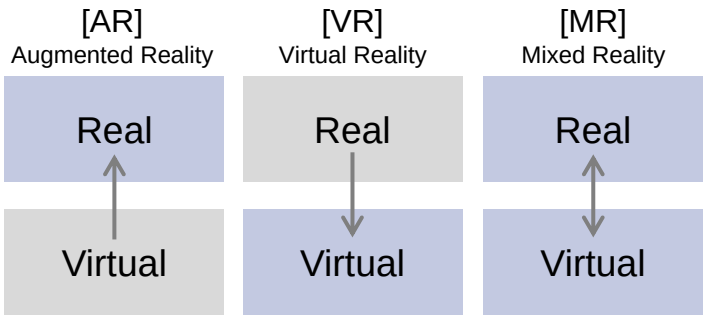


Automate non-routine tasks
Labor savings in heavy labor
Improve work quality

Overview of digital twins



<Examples of UX realization (XR)>



Note 1: Cases with only virtual space that are not merged with real space are not covered by this report
Note 2: Abbreviation for "Human-Cyber-Physical Space"
Source: Compiled by Mizuho Bank Industry Research Department based on Ministry of Internal Affairs and Communications materials and Cabinet Office materials

CPS initiatives: Companies and governments are promoting demonstrations, implementation, and practical applications

- Development of CPS is becoming more active for a variety of purposes, including productivity improvement, passing on skills, and addressing labor shortages, as well as for UX and urban development

Initiatives by companies and governments (excerpt)

[Goal]	[Example initiatives]
Productivity improvement	☐ Hitachi • Automatically collect data from production sites to understand process progress, improve quality, and automatically detect equipment defects ☐ Daikin • Predict production line slowdowns by using virtual spaces to reproduce processes such as pressing and painting
Passing on skills	☐ Olympus • Attaching sensors to skilled technicians to visualize their movements (this data is then used in training to develop the next generation of employees) ☐ Royal Host • Visualizing *omotenashi* (the Japanese concept of hospitality) in collaboration with the National Institute of Advanced Industrial Science and Technology (training by recreating the movements and awareness of skilled employees in virtual spaces)
Eliminating labor shortages (remote operation)	☐ Asahi Kasei • Introducing digital twins to hydrogen production plants, allowing remote support from skilled engineers in distant locations ☐ Kawasaki Heavy Industries • In collaboration with Microsoft, a collaborative work system called the "industrial metaverse" that can be used between remote locations was developed
UX	☐ Komatsu • Realized a system that digitally reproduces the topography of work sites and optimally controls all processes (improves safety and efficiency of site management) ☐ BMW • BMW is 3D scanning their factories around the world and converting them into data, and is selling licenses to external parties for their own design data and construction know-how
Urban development	☐ Toyota • In moving towards the construction of a smart city ("Woven City"), Toyota is using VR spaces to simulate people flows and traffic (such as from autonomous driving) ☐ Singapore government • The government is creating a digital twin of the entire country, which can then be used for urban development and infrastructure management, etc.

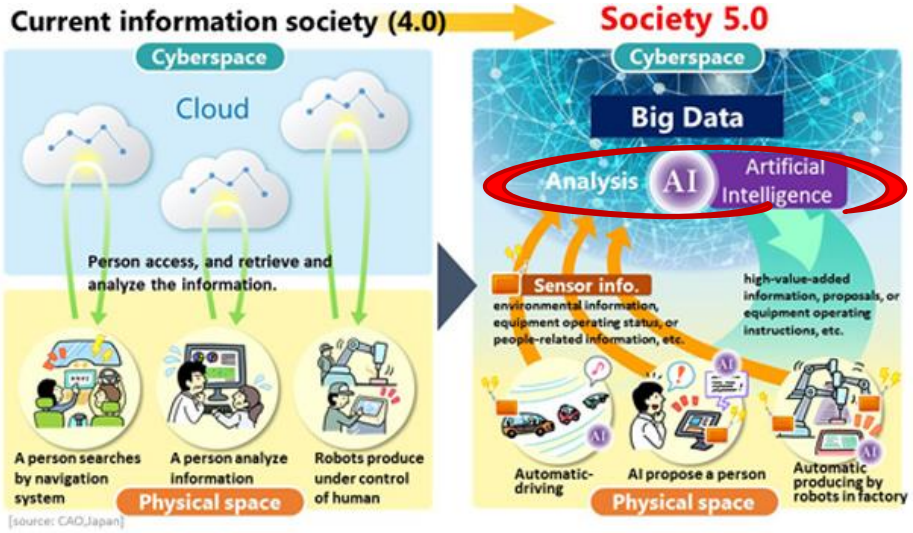
Source: Compiled by Mizuho Bank Industry Research Department based on publicly available information

The "Society 5.0" future that Japan aspires to is set around CPS

- In its 5th Science and Technology Basic Plan, the Japanese government proposed Society 5.0 as a vision for the future of society. Society 5.0 is expected to be a "super smart society" where cyberspace and physical space are highly integrated, and AI will play an important role in realizing this.

Society 5.0 worldview: A "super smart society" centered around people

"Super smart society"
A super smart society is characterized as "A society where the various needs of society are finely differentiated and met by providing the necessary products and services in the required amounts to the people who need them when they need them, and in which all the people can receive high-quality services and live a comfortable, vigorous life that makes allowances for their various differences such as age, sex, region, or language," and is expected to bring prosperity to people.



Economic development	Solving social issues
● Increased energy demand ● Increased food demand ● Longer lives and aging ● Intensifying international competition ● Concentration of wealth and regional inequality	● Reducing GHGs ● Increasing food production, reducing waste/loss ● Reducing social costs ● Sustainable industrialization ● Redistribution of wealth and correction regional inequalities

Incorporates cutting-edge technologies such as IoT, robots, and AI into all industries and social activities, and provides services that minutely respond to diverse needs without disparities

Towards Society 5.0

Balancing economic development and solving social issues

[Points for spreading Society 5.0]

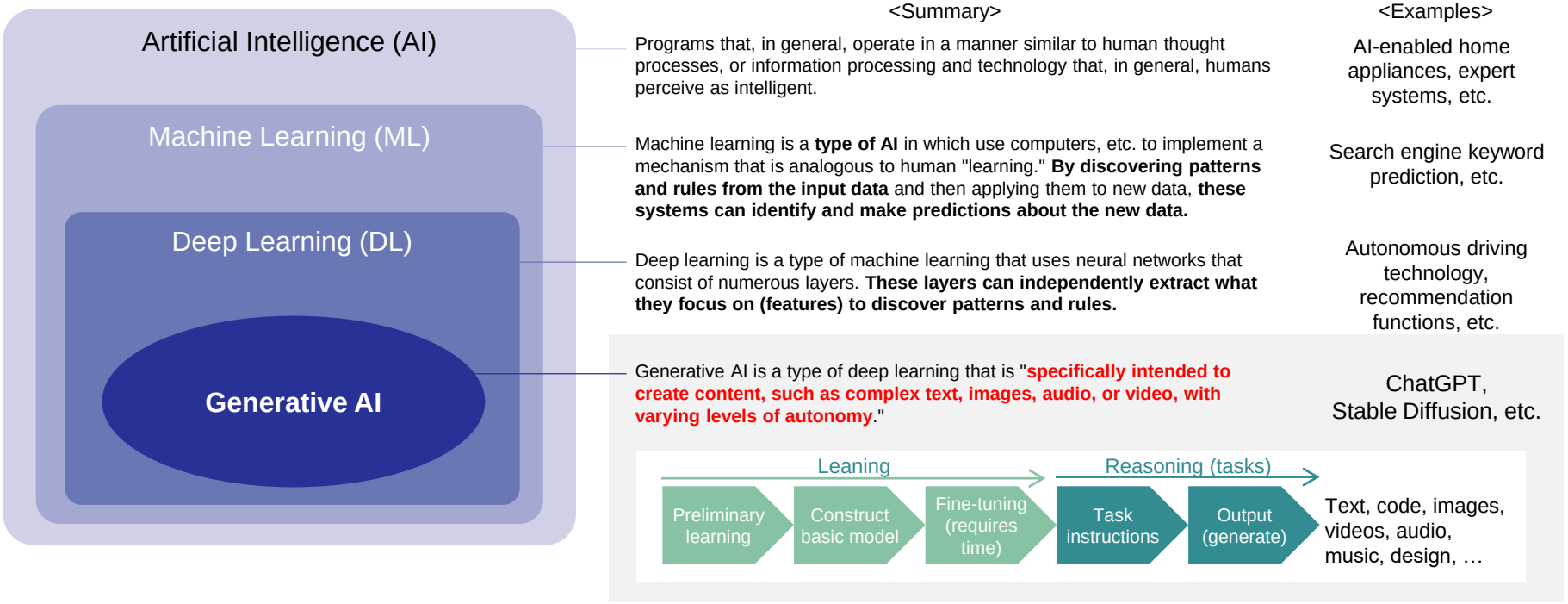
AI (analytical ability) | Data integration | Data compression/ security | Security | Privacy | Cost | …

Source: Reproduced from the Cabinet Office website (https://www8.cao.go.jp/cstp/society5_0/) by Mizuho Bank Industry Research Department

Changes from the environment in the past: The emergence of generative AI: What is generative AI?

- Generative AI is one of the application fields of deep learning within machine learning, which is an AI field.
- By using an AI model that has been trained in advance on large amounts of data and by giving it instructions via text, etc., generative AI can newly generate a variety of original content based on the learning data, such as images, videos, music, audio, text, software code, and product designs, etc.

The relationship between artificial intelligence, machine learning, deep learning, and generative AI

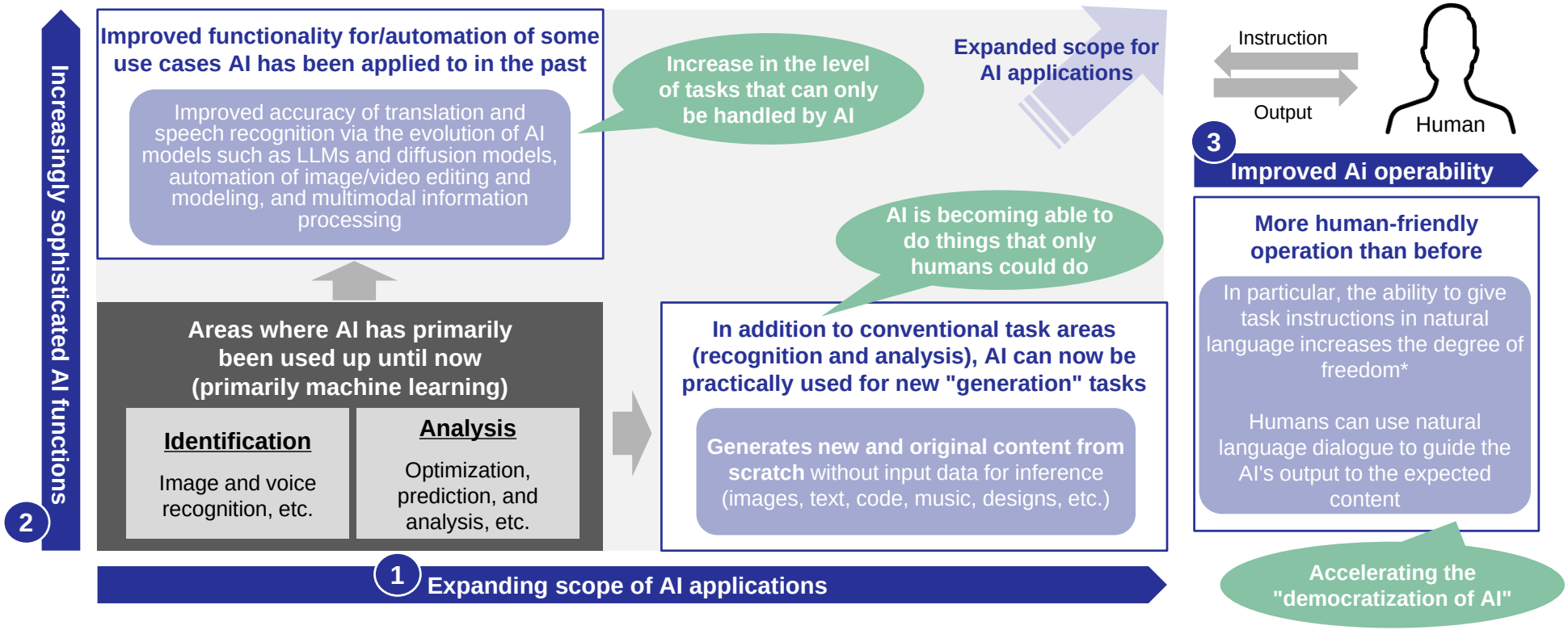


Note: Mizuho Bank, *Trends and Industrial Impact of Generative AI (General Chapter)*, "How Will Generative AI Change Industry?" Mizuho Industry Research No. 74 (December 2023)
Source: Compiled by Mizuho Bank Industry Research Department based on the Information and Communications in Japan white paper by the Ministry of Internal Affairs and Communications and other publicly available information.

Changes from the environment in the past: The advent of generative AI is expanding the scope of AI applications

- Up until now, the main application areas for machine learning have been recognition/identification processing, numerical predictions/analysis, and anomaly detection, etc.
- Generative AI and related technologies are bringing about changes such as (1) expanding the scope of AI applications, (2) increasing the sophistication of AI functions, and (3) Improving the operability of AI.

Changes that generative AI will have on the traditional scope of AI applications

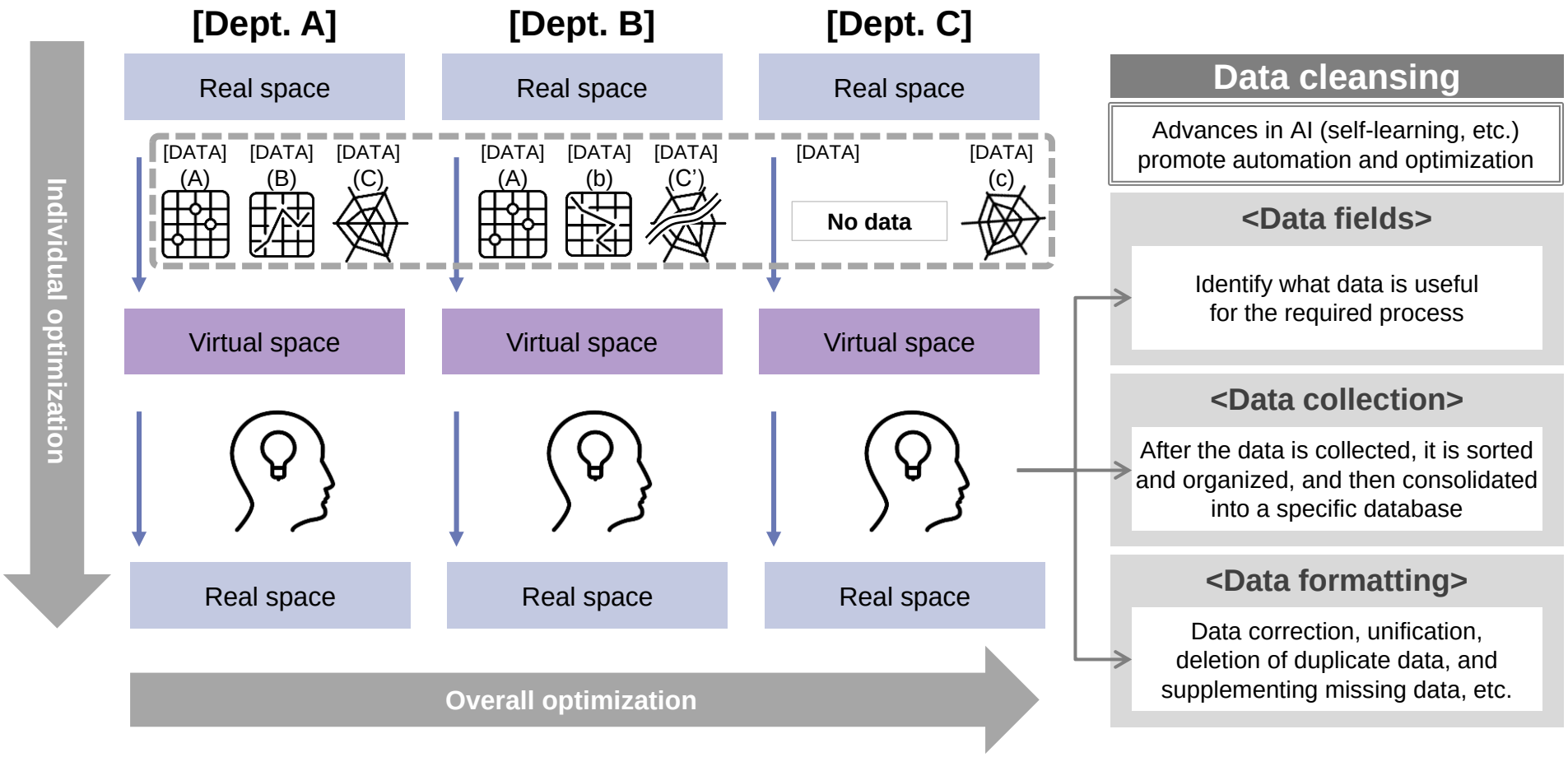


Note: Mizuho Bank, *Trends and Industrial Impact of Generative AI (General Chapter)*, "How Will Generative AI Change Industry?" Mizuho Industry Research No. 74 (December 2023)
Source: Compiled by Mizuho Bank Industry Research Department

Changes from the environment in the past: Expectations that AI advances will lead to more efficient data cleansing

- Data cleansing, which converts data into a form that can be analyzed, is essential for building highly accurate analytical models. Currently, a considerable amount of effort is devoted to preprocessing data before analysis, but advances in AI will facilitate more complex automation and optimizations.

Missing or inconsistent data impedes both individual optimization and overall optimization



Source: Compiled by Mizuho Bank Industry Research Department based on publicly available information

Changes from the environment in the past: Worldviews may suddenly change when AGI appears

- If a "weak" AI specialized in a specific area evolves into a self-propelling "strong" AI, then it is expected that the utility of CPS will dramatically expand.

Evolution of AI and impact on CPS (Mizuho hypothesis)

ANI (Artificial Narrow Intelligence)
- Shows the ability to take over some of the work done by humans in a specific field

AGI (Artificial General Intelligence)
- Like humans, can learn from past experiences and deal with a variety of problems other than those it was programmed for

ASI (Artificial Super Intelligence)
- AI that surpasses human intelligence in all aspects

SoftBank Group Chairman & CEO Son

(SoftBank World 2023 on Oct. 4, 2023)
- AGI will surpass humankind's total intelligence by a factor of 10, it will affect every industry, and the **AGI world is coming within the next 10 years**.
- Furthermore, 10 years later, the ASI world will come.

Impact on CPS

Data collection
- Advanced data collection
  - Increase in types and amounts of data that can be collected, incl. text, video, audio
- Automation
  - Automatically collect necessary data (by itself will determine and correct course if necessary)

Analysis
- Increased amount of data that can be analyzed
- Improved accuracy (remove data errors)
- Acceleration: Fast and efficient processing
- Self-learning: Searches for solutions on its own when encountering new problems

The entire system can be controlled accurately and quickly, which makes it possible to flexibly respond to changing situations

Source: Compiled by Mizuho Bank Industry Research Department based on SoftBank Group IR and publicly available information

Points for realizing AGI: Japan's strengths in robotics

- The three main components of AGI are the cognitive architecture, machine learning, and cognitive robotics, which aims to give human-like cognitive functions to robots.

AGI components and challenges in realizing them

<AGI components>

1. Understanding human intelligence

Cognitive architecture

A blueprint for creating artificially computable processes that behave like humans, or processes that exhibit some kind of intelligence

2. Machine learning

AI reads data, learns on its own, and improves its judgement and processing systems

3. Cognitive robotics: Giving intelligence to robots

Cognitive developmental robotics

Simulations using robots and computational models are fully utilized to design a constructivist understanding of the human cognitive development process and to design robots that coexist with humans based on this understanding

Symbol emergence in robotics

Machine learning and robotics technologies are used to realize a process by which a body-based subject acquires concepts and language through interactions with its environment

Social intelligence robotics

Achieves the acquisition of intellectual qualities that are essential for humans to live a social life, such as communality, sociability, and communication skills

Explore methods and algorithms for robots to perform cognitive processes such as sensing, perceiving, thinking, making decisions, and acting

AGI is based on an algorithmic understanding of information flow, processing methods, and decision-making in cognitive processes.

<Challenges for realizing AGI (example)>

Frame problem	When an AI thinks, it is difficult for it to accurately grasp the situation in the real world and to select only the information that is necessary for the action to be taken, and calculating all possible scenarios creates enormous amounts of information (not all scenarios can be processed)

Source: Compiled by Mizuho Bank Industry Research Department based on publicly available information

Challenges to spread: Dealing with high power consumption: Directions other than increasing scale are also important

- Developing and using basic models requires an enormous amount of computational complexity, which poses environmental and cost issues due to the high power consumption.
  - In addition to scaling up based on the Scaling Laws, there is also active movement towards creating lighter models with about the same level of accuracy, and co-creation across companies via the development and utilization of open-source models.
- There are also moves towards developing multimodal models with the aim of achieving greater versatility.

Evolutionary directions for basic models

Scaling up

Competition to improve performance via scaling up will continue for the time being

◆ Based on the Scaling Laws for Neural Language Models, performance is improved by increasing the number of parameters (model size) and the amount of data used for learning.

✓ **Environmental burden and cost issues due to high power consumption***
✓ **Physical and financial limitations in building data centers outfitted with high-performance GPUs**

Efficiency, practical application, and co-creation

Improving learning efficiency and model efficiency

✓ Search for a balance between the number of parameters and dataset size to achieve higher performance with the same amount of computational complexity
✓ Explore ways to reduce the number of parameters and computational load through quantization while maintaining answer accuracy

Domain specialization

✓ By specializing in a specific domain, the fields and vocabulary included in the dataset can be narrowed down, and practical accuracy can be demonstrated while suppressing model size

Open-sourcing

✓ Increasingly, models are being released as open source due to concerns that the development of base models, which requires enormous resources, will be monopolized by some companies
✓ Several base models are now available for commercial use (Dolly2.0, StableLM, LLaMA2, etc.)

Increasing momentum towards more efficient and practical model development via co-creation amongst players

At the same time, there is also parallel development towards large-scale models that combine visual, auditory, and tactile sensations

Shift to multimodal models

◆ Learning and inference to enable integrated processing of multiple information formats, such as text, images, audio, numbers, and sensory information, etc. (comprehensive processing of text, images, and audio has already been achieved with some base models such as GPT-4. Even more sophistication is being targeted)

Note: Mizuho Bank, *Trends and Industrial Impact of Generative AI (General Chapter)*, "How Will Generative AI Change Industry?" Mizuho Industry Research No. 74 (December 2023)
Source: Compiled by Mizuho Bank Industry Research Department based on publicly available information

Challenges to spread: Dealing with high power consumption: Evolutions in devices and sensor technologies are also necessary

- The aim is to expand CPS applications by developing ultra-low power consumption IoT chips and sensor devices, and Japan needs to secure a budget to promote research and development.

Cross-ministerial Strategic Innovation Promotion Program (SIP) Phase 2: Intelligent Knowledge Cyber and Processing Infrastructure Integrating Physical Domains

<Gaps that need to be resolved to realize Society 5.0>

Technical gap	
Collect	・Seamless and low-power consumption collection of data from all kinds of people ⇒All people, things, and data can be virtualized and uniformly processed
Connect	・Increase amount of communications data, increase number of connections, and improve wireless quality ⇒Wireless connectivity in any environment, and uniform control of everything
Share knowledge and information	・Real-time control, and physical AI ⇒Improve efficiency and regional aggregation through processing, value creation, and local production for local consumption of data within physical spaces

Gap in CPS implementation	
Expertise	・Many CPS are for specific purposes/experts ⇒Use generalization to reduce barriers to entry and labor
Infrastructure (capital investment)	・Continuously operate by compensating for deficiencies without replacing existing systems as much as possible ⇒Ensure system sustainability, and upgrade a familiar environment at low cost
Range of applications	・Systems that anyone can use, thereby expanding range of uses ⇒Create local ecosystems, intensify and individualize the horizontal development of demonstrations

[Project overview]

- Period: FY2018-2022
- FY2022 budget: JPY 1.61 billion
- PD: Hideyuki Saso (Specially Appointed Professor, Tokyo Institute of Technology)
- Research sub-themes:
  1. Common platform technology for development of IoT solutions
  2. Ultra-low-power-consumption IoT devices and innovative sensor technology
  3. Societal implementation technology for achieving Society 5.0

From FY2023 onwards, aim to accelerate implementation with the established consortium at the core

[R&D of ultra low-power consumption data collection system]

DSPC (Device & system platform development center) Research supervision and demonstration testing, etc.	Kobe University	Development of ultra low-power consumption SoC Development of vital sensing algorithms
	Toshiba	Development of SiGe accelerometers Development of gyroscopes
	Tokyo Institute of Technology	Development of backscatter sensing technologies
	Alps Alpine	Development of backscatter sensing technologies

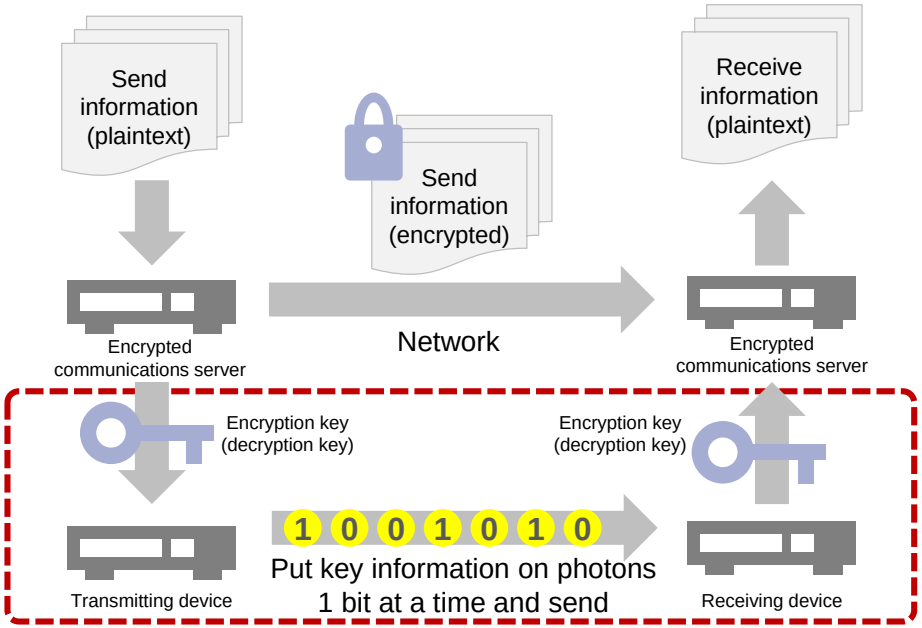
(R&D targets) low-power consumption SoC, high-efficiency energy harvesting, ultra low-power consumption wireless transmission technologies, ultra low-power consumption SiGe (silicon gel) accelerometers, and high precision/low-power consumption gyroscopes

Note 1: Technology to generate electricity by harvesting energy such as sunlight, lighting, vibrations generated by machinery, and heat
Note 2: Communication method that uses radio wave reflections. Achieves power savings because the device itself does not emit radio waves
Source: Compiled by Mizuho Bank Industry Research Department based on NEDO and *SIP Intelligent Knowledge Cyber and Processing Infrastructure Integrating Physical Domains Research and Development Plan* by the Cabinet Office

Challenges to spread: Dealing with high power consumption: Can cybersecurity be ensured in a connected world?

- While various benefits can be expected from connecting people, goods, money, and information even more than in the past, it is also expected that the risk of cyberattacks by malicious third parties will also increase, so robust security is essential (e.g. by utilizing quantum cryptography)

Quantum cryptography/communication mechanism



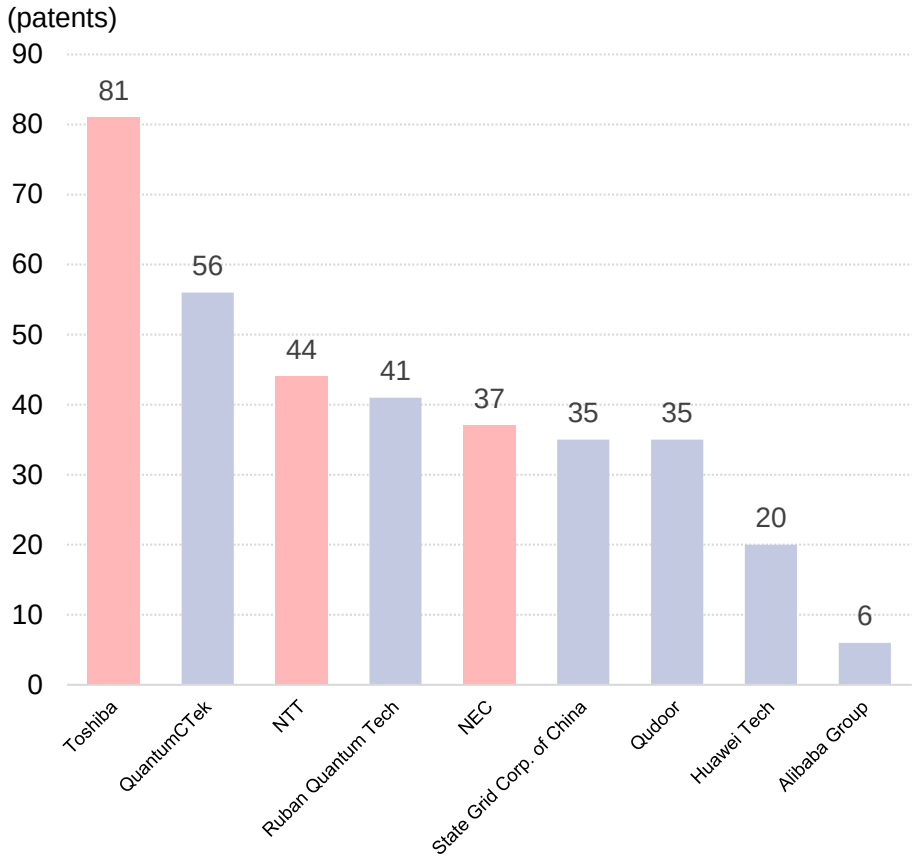
Quantum Key Distribution (QKD)

[Characteristics of quantum cryptography]

- ☐ Photons are indivisible
  - → If the number of photons decrease, it is proof that the communication is being eavesdropped on
- ☐ Photon states cannot be completely copied (copying changes the state)
  - → If the photon state changes, there is a suspicion of eavesdropping

Source: Compiled by Mizuho Bank Industry Research Department based on publicly available information

Top number of quantum cryptography-related patents by affiliation and applicant (cumulative total from 2000 to 2023)



Note: Patents related to quantum cryptography and quantum communications, etc. Toshiba includes both the English and Japanese spellings for the company.

Source: Compiled by Mizuho Bank Industry Research Department based on JDream Innovation Assist

Japan has the potential to lead the world in terms of CPS

[Primary CPS components]

Sensing (acquiring data) X **Computing** (processing data) X **Actuation** (operating machinery, etc.) X **Application** (target data source/use)

[Abundance of real data*]

- Industrial clusters (products, parts, equipment, materials, etc.)
- Aging society (medical care, nursing care, insurance, etc.)

[Sensing technologies]

- Product group with strong global presence
- Leading the way in developing innovative sensing technology

[Global leaders in the "control" field]

- Control devices that support global *monozukuri*
- Next-generation technologies(artificial muscles/soft actuators)

[Globally competitive components]

- Drive devices (various motors), NC devices
- Advanced materials to make things lighter/thinner/shorter/smaller

[Key factors]

[AI development]

- The emergence of generative AI is expected to improve CPS efficiency and expand its scope of applications
- Although there are many uncertainties, the evolution of AGI may lead to a high degree of independence
  - Japan also has a strong presence in robotics, a key component of AGI development

[Infrastructure]

- Electricity: Data acquisition and analysis requires more electricity than ever before. Innovative sensors and high-performance materials will be key for reducing power consumption
- Cyber security: In an interconnected world, ensuring security is essential. There are high expectations for new technologies that ensure security, such as quantum cryptography, where Japanese companies have strengths

Note: Data obtained directly from various sensors, IoT devices, information appliances, and automobiles, etc.
Source: Compiled by Mizuho Bank Industry Research Department

IV. Structural Changes in the Automobile Industry and the Impact of CPS Utilization

Summary: Structural changes in the automobile industry and the impacts of CPS utilization

- ***Monozukuri***
  - Structural changes in the automobile industry are forcing peripheral industries such as parts and materials to restructure their production systems and value creation
  - Shift to a system that efficiently creates high value-added products by utilizing CPS. Source of strengths is shifting from "craftsmanship" to "data"
- **Services**
  - With the spread of BEVs, demand for electricity is increasing, and new services will emerge that use vehicle batteries as distributed power sources
  - If CPS becomes more widespread, it will not only improve the productivity of individual companies, but also realize overall optimizations through collaborations between industries

Monozukuri	Vehicles	☐ Quantity perspective: Automobiles exceed other products in terms of scale of the final products (value, weight), and peripheral industries such as parts and materials will need to rebuild their production systems ☐ Quality perspective: While suppliers have a history of promoting the development of next-generation technologies and products due to strict requirements, the relative decline in automobiles' added value may limit conventional value-creation mechanisms
	CPS	☐ Advances in accuracy, speed, and efficiency in each process from procurement, manufacturing, and shipping ☐ In research and development, CPS can be used for development in areas that are based on *suriawase* and *tsukurikomi* (on the other hand, complete digitization is difficult, and there is still room to take advantage of existing strengths)
Services	Vehicles	☐ With the spread of BEVs, electricity demand is expected to increase by about 55.5 billion kWh (3~5% of the assumed electricity demand in 2050). On the other hand, by utilizing BEV batteries as a distributed power source, up to 144.3 billion kWh of electricity can be used as a source of supply ☐ The above is also expected to reduce fuel costs by reducing the amount of zero-emission thermal power generation required to generate electricity in the event of power supply shortages (estimated to have an impact of over 1 trillion JPY)
	CPS	☐ Low productivity, which has been an issue for both manufacturing and non-manufacturing industries, will be greatly improved by optimizing operations through collaboration between industries ☐ The number of people active in virtual spaces will increase due to improved metaverse convenience. Also expected to be used as a new branding and marketing method ☐ Data-driven simulation contributes to reducing urban maintenance and management costs
	Vehicles × CPS	☐ Birth of services that transcend industry boundaries (examples) – V2G: The use of storage batteries as power infrastructure will spread due to the integration of distributed power sources, smart grids, and the spread of BEVs – MaaS: Building databases that integrate mobility and services to provide seamless operation and dispatch operations/services

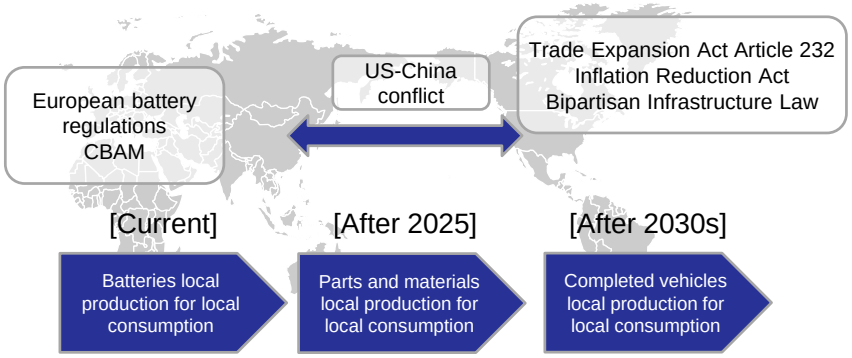
Source: Compiled by Mizuho Bank Industry Research Department

Steel Industry case : Decreased domestic crude steel production

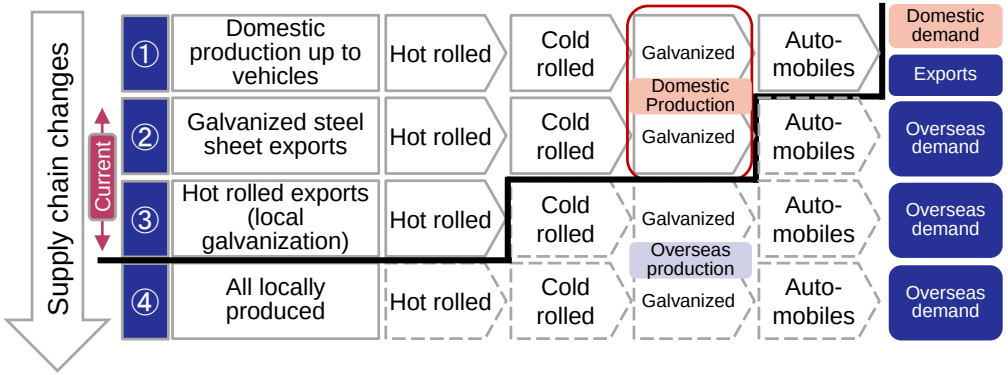
- In the automobile industry, in the medium term it is expected that, as the shift to electrification continues, for completed vehicle manufacturing there will be progress in local production for local consumption and in local procurement. In the past, exports of galvanized steel sheets have decreased and switched to local supply chains
- Domestic crude steel production for 2050 is assumed to be 50 to 67 million tons. Assuming maximum progress in local production for local consumption, primarily for automobiles, and that domestic production will only satisfy domestic demand, then 50 million tons is estimated (zero steel exports)

Structural changes in automobile industry (3): Progress on local production for local consumption

[Progress in local production for local consumption]

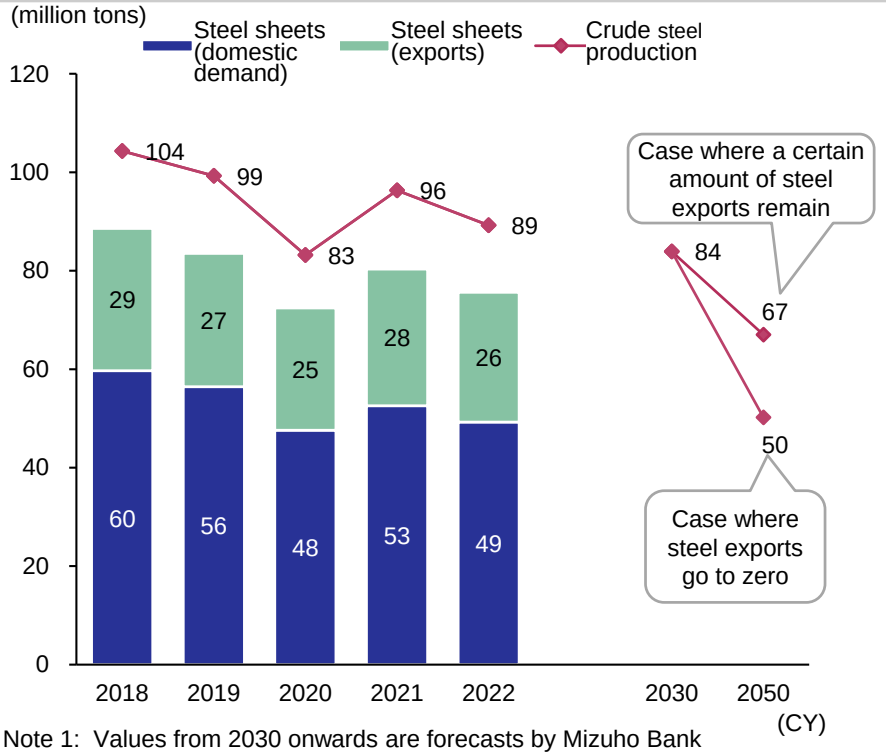


[Example of supply chain changes for galvanized steel sheets]



Source: Compiled by Mizuho Bank Industry Research Department

Domestic steel production forecast

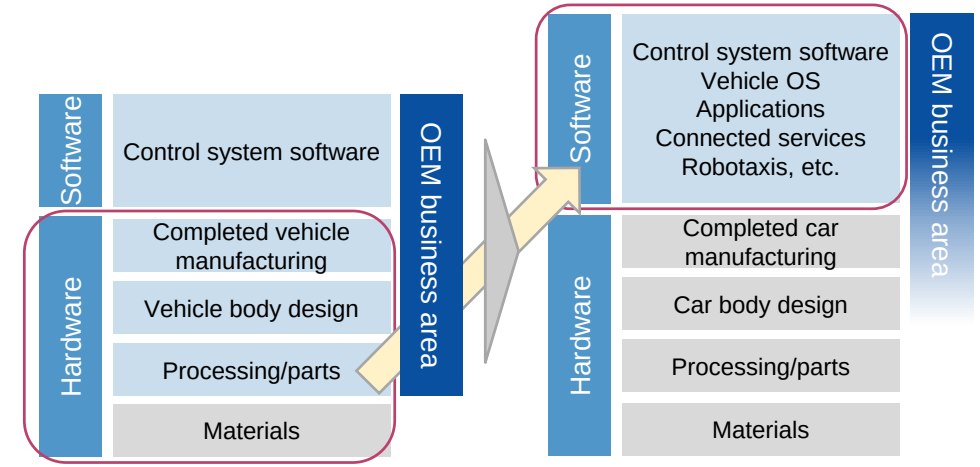


Note 1: Values from 2030 onwards are forecasts by Mizuho Bank
Note 2: If no exports remain, then imports will accordingly be switched to domestic production
Source: Compiled by Mizuho Bank Industry Research Department based on materials from the Japan Iron and Steel Federation

Steel Industry case: Lowered barriers to overseas general-purpose products

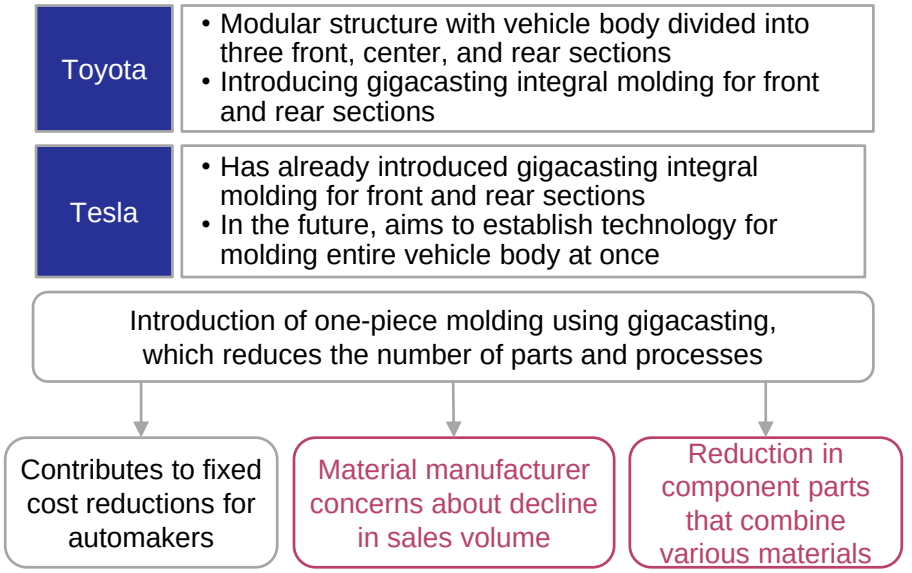
- With the progress in automobile electrification and intelligence, there is a possibility that opportunities for *tsukurikomi* and *suriawase*, which have been strengths of Japanese companies, will decrease and that their effects will become diluted
  - Concerns that the sources of added value in automobiles will shift from hardware to software, and that the importance of materials will become diluted
  - Concerns that the number of parts and processes will be reduced as gigacasting spreads

Structural changes in automobile industry (2): Progress in electrification and intelligence



There are concerns that the sources of added value will shift from hardware to software, and that the importance of materials will become diluted

Structural changes in automobile industry (3): Spread of gigacasting



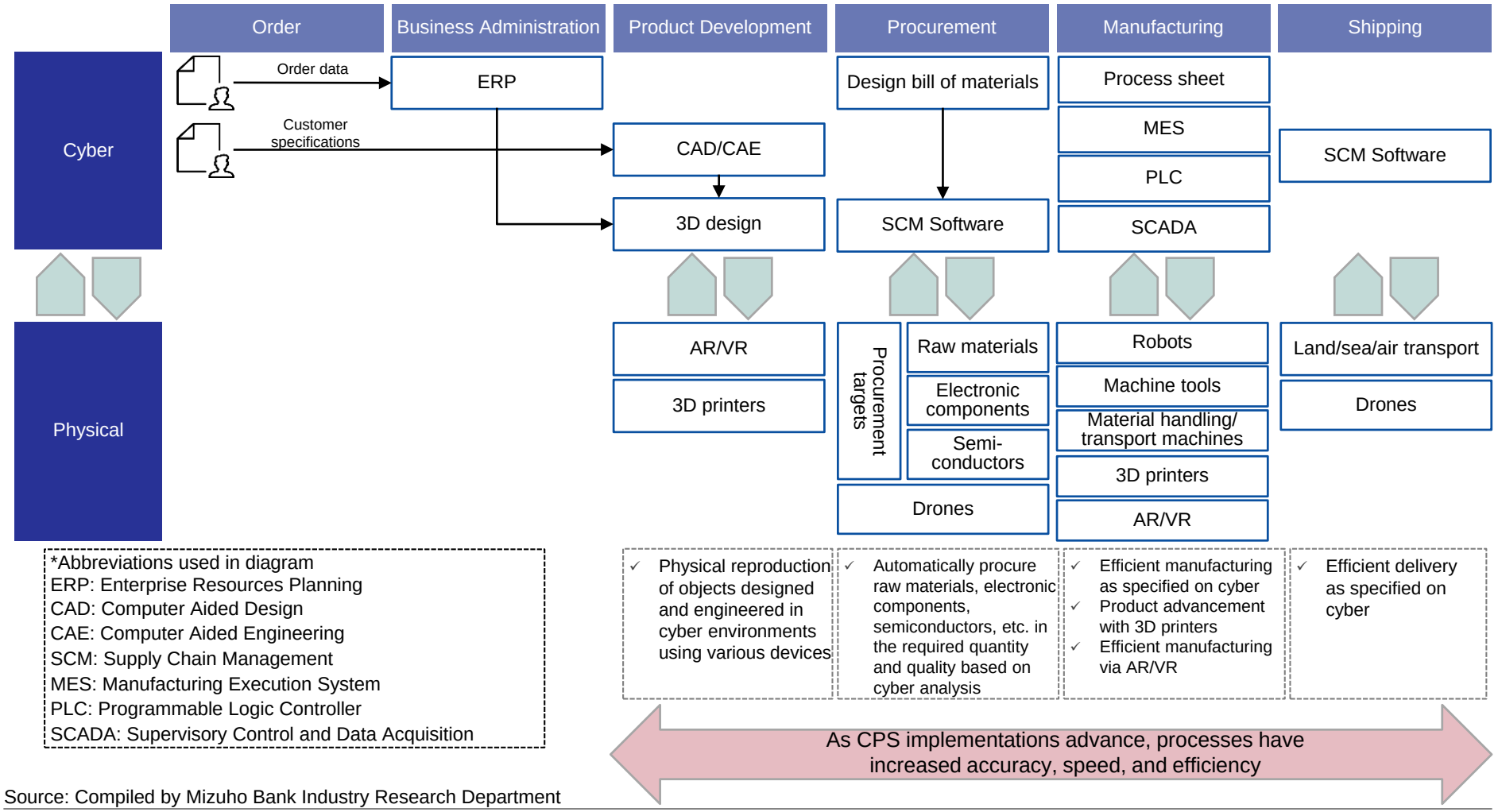
Possibility that opportunities for *tsukurikomi* and *suriawase*, which have been strengths of Japanese companies, will decrease and that their effects will become diluted

Note 1: The "completed vehicle OEM business area" includes the business areas of affiliated suppliers
Note 2: Tesla refers to gigacasting as "Giga Press"
Source: Compiled by Mizuho Bank Industry Research Department from various press articles

As CPS implementations advance, manufacturing processes will be more sophisticated

- In *monozukuri*, cyber and physical systems closely work together in each process
  - Promotes increased accuracy, speed, and efficiency in each progress, enabling *monozukuri* that faithfully produces products at the right time

Image diagram for advanced manufacturing processes

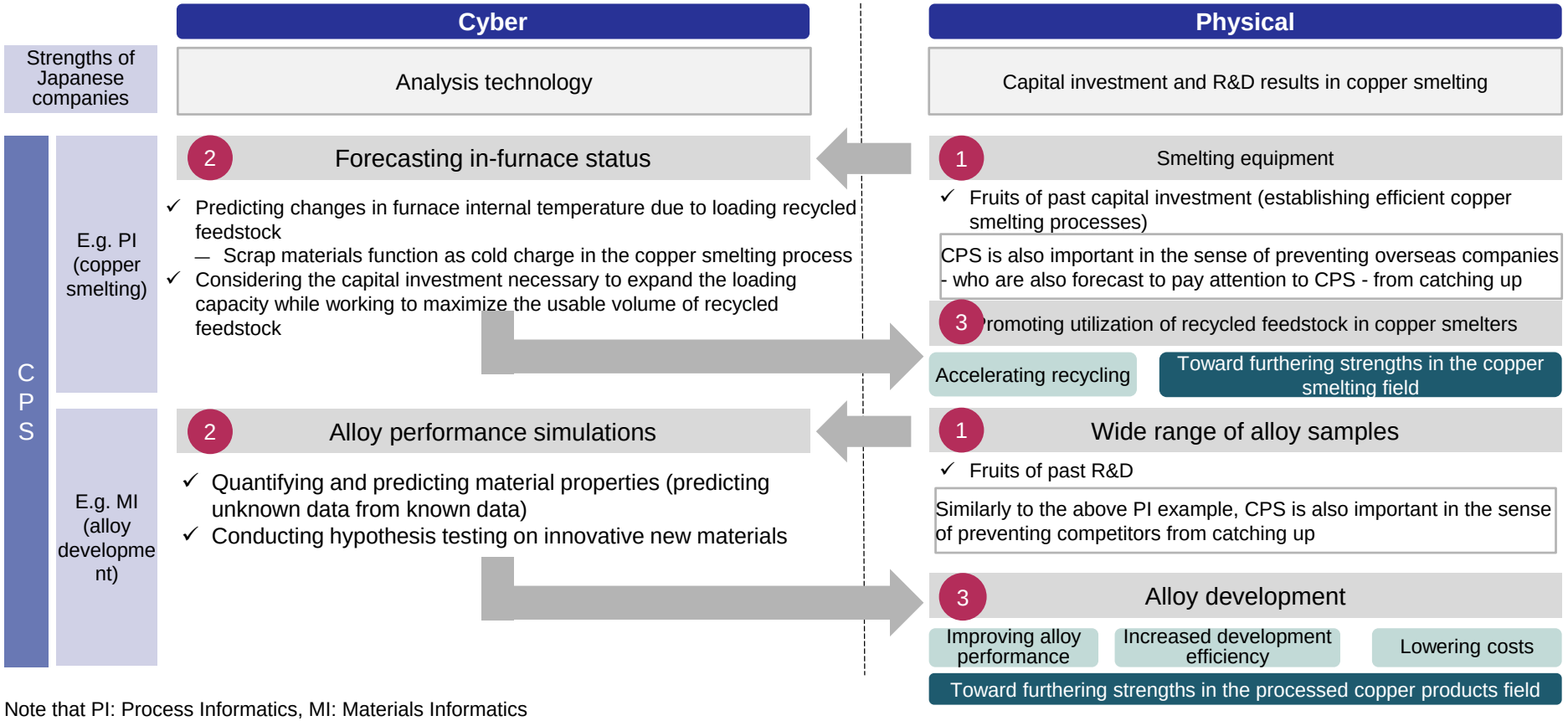


Source: Compiled by Mizuho Bank Industry Research Department

Non-Ferrous Metals Industry case: Improving R&D efficiency through implementing CPS

- Utilization of CPS is anticipated to progress as a technology contributing to promoting recycling in copper smelters and to producing future new high-functionality materials (e.g. high-performance alloys)
- Japanese companies have strengths in holding a wide range of alloy samples and efficient production processes, the fruits of past capital investment and R&D. Based on this, it is considered that implementing CPS could also deliver competitive advantages

CPS in the non-ferrous metal industry (examples of copper smelting and alloy development)



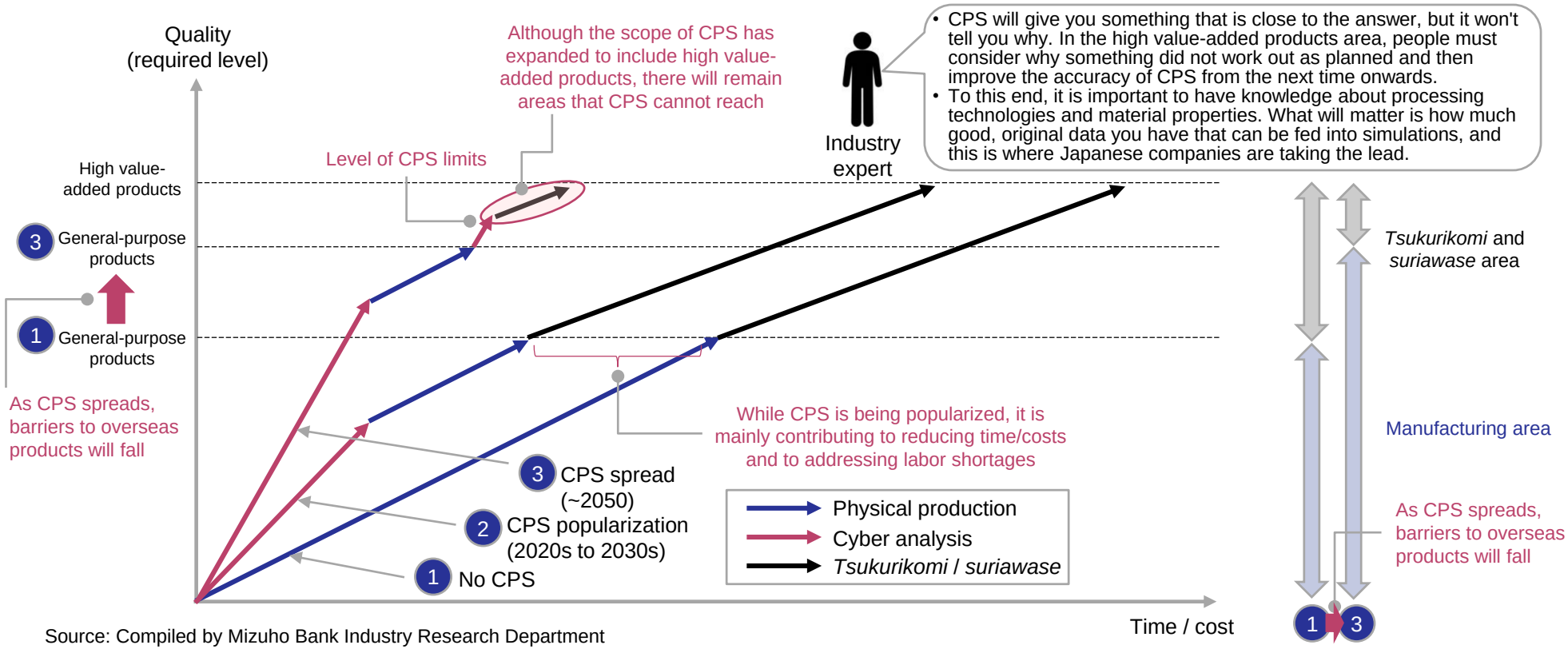
Note that PI: Process Informatics, MI: Materials Informatics

Source: Compiled by Mizuho Bank Industry Research Department based on publicly-available information

[Mizuho hypothesis] Although there will be progress in implementing CPS, there are some areas CPS cannot reach

- While CPS is being popularized, such as right now, it is mainly contributing to reducing time/costs and to addressing labor shortages. But, in a world where CPS has become widespread and commonplace, it is expected that CPS will be adopted to a certain extent even in the high value-added products area
- However, even if CPS implementation makes even further strides, it is thought that there will still be some areas that CPS cannot reach – that is, the *tsukurikomi* and *suriawase* areas that require human input. When also competing in the high value-added area, it will be important for Japanese companies to maximize their strengths, such as advanced processing techniques and knowledge of material properties, as well as to have high-quality analysis data that can be fed into CPS

Illustration of the effects of introducing CPS (Mizuho hypothesis)



Source: Compiled by Mizuho Bank Industry Research Department

Future vision for monozukuri: Source of strengths is changing from "craftsmanship"

	Present	Future (around 2050)
Production	☐ Establishing production know-how at domestic mother factories centered on skilled workers and passing on know-how to overseas ☐ Although movement to utilize digital technology is gradually expanding, there is still a reliance on on-site experience and know-how	☐ Significantly improved efficiency through linkage with cyberspace, including review of manufacturing processes and coordination between production processes ☐ Automated production through remote operation and monitoring of robots and 3D printers in some factories
Research & Development	☐ Creating value-added products/custom-made products through *suriawase*, which takes advantage of industrial clusters, and *tsukurikomi*, which has a close connection to customers	☐ Dramatically improved speed and accuracy of data analysis and simulation. Increased development efficiency and lower costs
Competition	☐ Japanese companies, which excel at the upper middle to high-end areas, compete with European and American companies in the same areas, but are separated from companies (China and Korea, etc.) that specialize in low-end to lower middle areas	☐ As overseas companies also promote the use of CPS, the barriers to high-value-added products, an area in which Japanese companies excel, may decline ☐ On the other hand, there will remain room for things that cannot be realized with CPS. Additionally, data accumulation is the key to improving CPS accuracy
Design	☐ End users' tastes are diversifying, and mass customization is gradually becoming more popular. ⇒Responding to "low volume, high variety"	☐ Increasing need for personalization in both hardware and software (including contents) ⇒ Responding to "low volume, high variety" and "variable variety, variable volume"
Communication Environment (prerequisites)	☐ Domestic 5G population coverage rate will reach 97% (FY2022), but mainly in the 700MHz~3.5GHz frequency range (platinum and mid-band)	☐ 7~8G standardization and significant advances in communication functions (high speed, high capacity, ultra-high reliability, low latency, and multiple simultaneous accesses) ☐ Low-Earth orbit satellites in widespread use, the number of areas around the world where radio waves cannot reach will be minimized (super coverage expansion)

[Changing source of strengths]

Until now ***~Monozukuri*, a Japanese craft~**

- ☐ Industrial cluster built around automobiles
- ☐ Veteran technicians represented by their craftsmanship and their ability to do on-site *kaizen*

Future ***~Monozukuri* 2.0 with data as the strength~**

- ☐ Build own databases and digitize own in-house process engineering know-how
- ☐ Data on final products and parts/materials is required to improve CPS accuracy

Source: Compiled by Mizuho Bank Industry Research Department

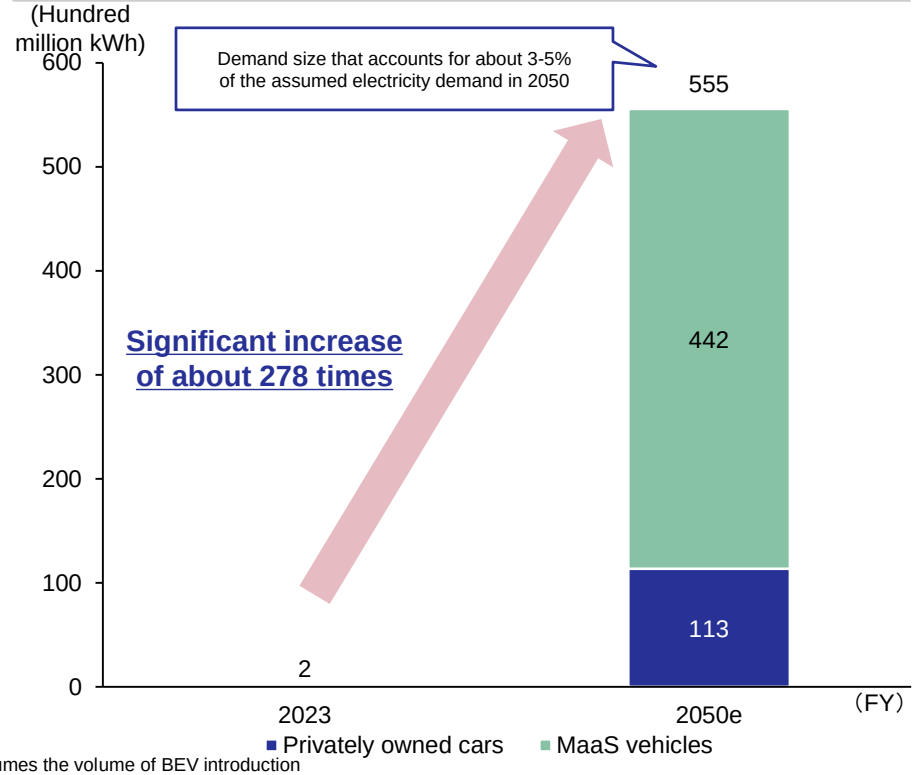
Impact on Energy Industry: [Our Estimate] With the mass introduction of BEVs, electricity demand is expected to increase by 55.5 billion kWh

- The estimated increase in domestic electricity demand with the mass introduction of BEVs was produced by focusing on passenger cars
  - By the cross-section in 2050, both privately owned vehicles and MaaS vehicles will be widespread
- By the 2050 cross-section, the number of BEVs introduced is expected to exceed 12.34 million vehicles, more than 76 times the current figure, and assuming annual mileage and electricity consumption remain the same, electricity demand will significantly increase to 55.5 billion kWh

Basis for electricity demand estimation due to the electrification of vehicles (focusing only on passenger cars)

Estimation logic	2023	2050 (Estimate by Industry Research Department)
BEV introduction volume (units)	Passenger cars: 162,000	Privately owned cars: 8,872,000 MaaS vehicles: 3,467,000
×		
Annual mileage (km)	Passenger cars: 7,800km	Privately owned cars: 7,800km MaaS vehicles: 25,500km
÷		
Electricity consumption (km/kWh)	Passenger cars: 6.1km/kWh	Privately owned cars: 6.1km/kWh MaaS vehicles: 2.0km/kWh
=		
Electricity demand for BEVs	Passenger cars: 200 million kWh	Privately owned cars: 11.3 billion kWh MaaS vehicles: 44.2 billion kWh

Forecast of increased electricity demand due to vehicle electrification



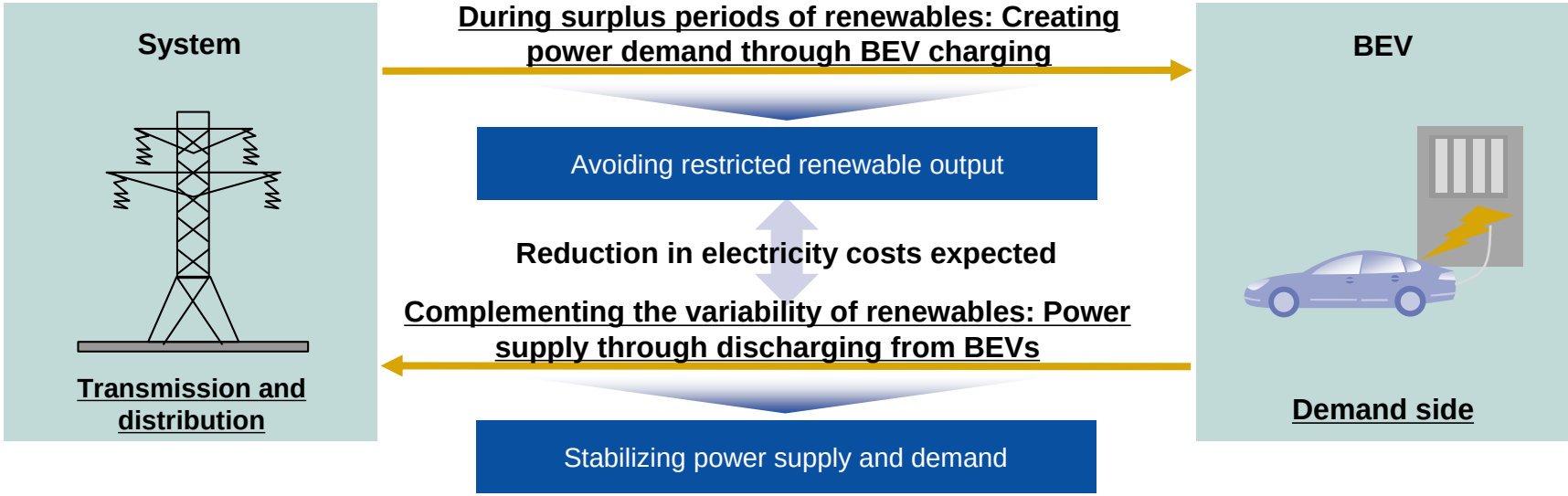
Note: The volume of BEV introduction for 2050 is estimated on a CY basis, but the electricity demand estimate assumes the volume of BEV introduction is the same on an FY basis

Source: Both charts created by Industry Research Department Mizuho Bank, Ltd. from the Ministry of Economy, Trade and Industry materials

Impact on Energy Industry: BEVs can become an important resource for stabilizing supply and demand.

- In 2050, the large introduction of variable renewables means charging BEVs during surplus periods of renewable energy and then utilizing their balancing function to complement the variability of renewables has become vital for supplying power.
  - During surplus periods, charging BEVs to create power demand can help avoid the restrictions in renewable output, promoting the effective use of surplus renewable power.
  - During periods without renewable generation, discharging from BEVs charged during surplus periods contributes to the stabilization of power supply and demand.
  - From a consumer perspective, charging during surplus periods of renewables allows for cheaper electricity rates. There is also the potential for reducing electricity bills through selling power.

The role of BEVs in an era with mass introduction of renewables

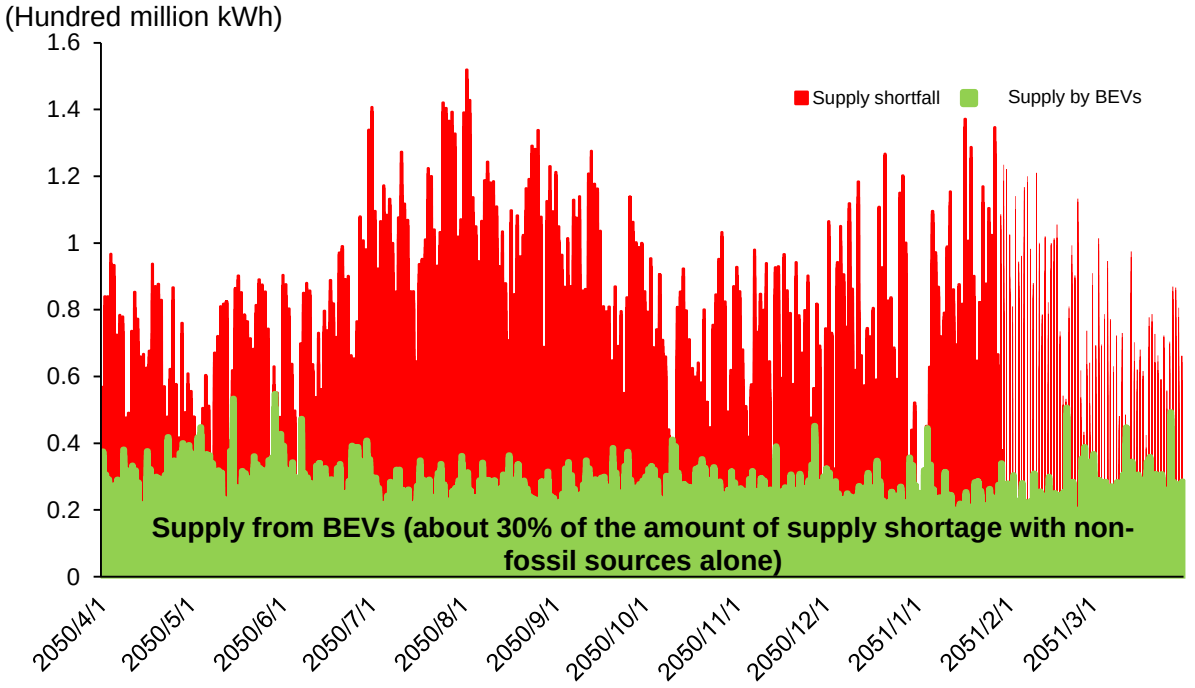


Source: Compiled by Industry Research Department Mizuho Bank, Ltd. based on a variety of published materials.

Impact on Energy Industry: [Our Estimate] The use of BEVs could partially substitute for zero-emission thermal power

- The estimate of the amount of power BEVs can provide hourly makes assumptions about BEV battery capacity and the utilization rate of BEVs based on charging and discharging during hours of non-usage, ensuring the necessary power for driving is secured.
  - The annual power amount BEVs can provide in FY2050 is expected to be about 144.3 billion kWh (about 30% of the supply shortage).
- In FY2050, there are hourly cross-sections where supply capability is insufficient with non-fossil sources alone, but the use of BEVs can improve the supply shortage to a certain extent.
  - Utilizing BEVs can reduce the generation volume of zero-emission thermal power needed during supply shortages, potentially reducing fuel costs.

Hourly supply shortage amount and power amount BEVs can provide in FY2050



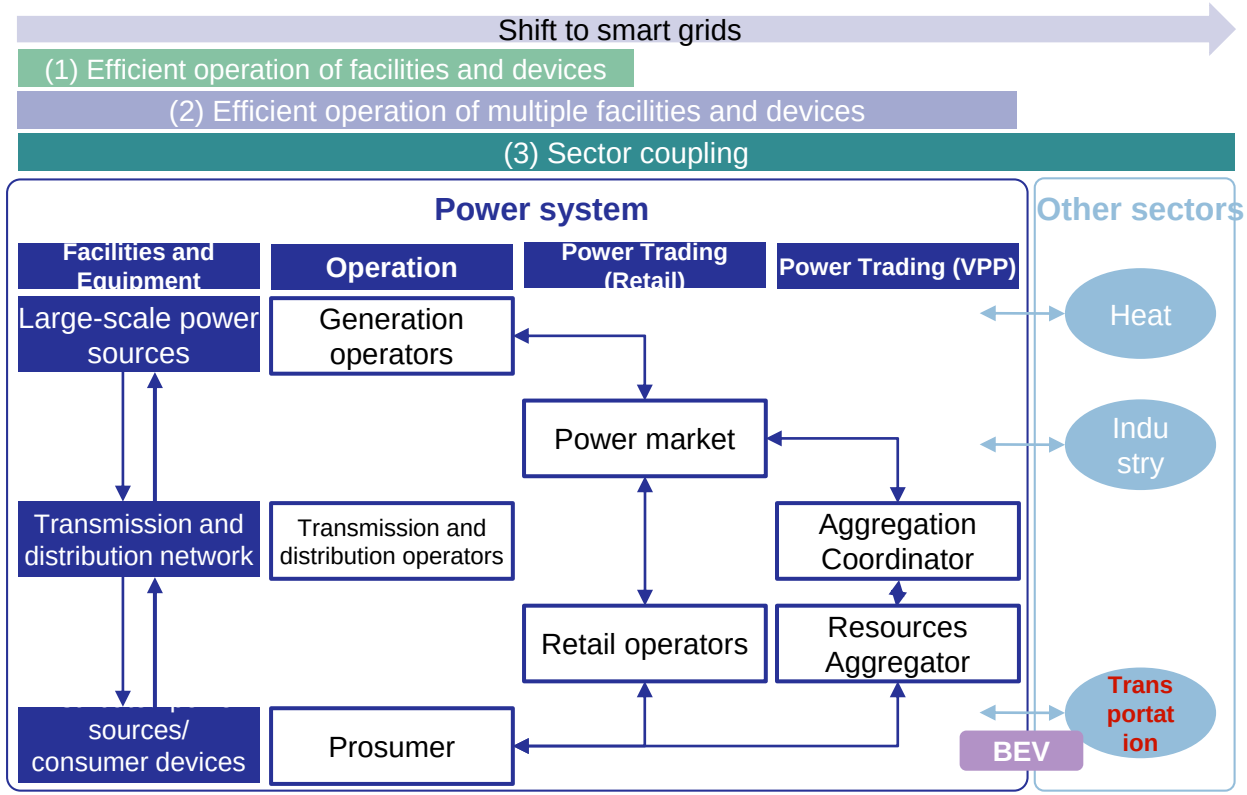
Utilization rate	Privately owned vehicles	Fluctuates hourly, considering usage time (0 to 20%)
	MaaS vehicles	About 80%
Storage Batteries Capacity	Privately owned vehicles	45 kWh/vehicle
	MaaS vehicles	126 kWh/vehicle
Power amount (Annual)	Privately owned vehicles	121.2 billion kWh
	MaaS vehicles	23.1 billion kWh

Source: Compiled by Industry Research Department Mizuho Bank, Ltd. based on a variety of published materials.

Decentralization, shift to smart grids, and mass introduction of BEVs lead to sector coupling with the transport sector.

- Currently, alongside efficient operation of individual facilities and devices using AI, etc., the construction of virtual power plants (VPPs) bundling distributed power sources and consumer devices that produce demand is progressively advancing towards smart grids.
- A power system with smart grids, starting with BEVs, can potentially lead to sector coupling through connections with the transport sector.

Examples of new business areas through the smart grid



Examples of new business areas

(1) Efficient operation of facilities and devices

- AI-based prediction of renewable generation volume
- Formalization of tacit knowledge of technicians in O&M of power plants
- Inspection of transmission lines by AI and drones

(2) Efficient operation of multiple facilities and devices

- Integrated control of distributed power sources and devices producing consumer demand at site level by HEMS, BEMS, FEMS
- Construction of VPP using aggregators
- Construction of microgrid using a distribution license

(3) Sector coupling

- Producing hydrogen with surplus renewables and utilizing it in industrial and transport sectors
- **Integration of energy management and fleet management**

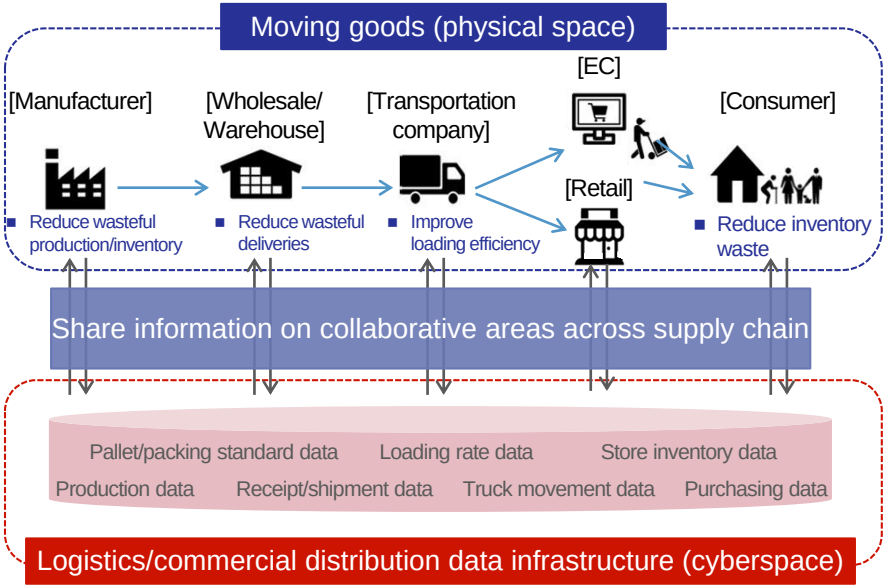
Source: Compiled by Mizuho Bank Industry Research Department

Logistics case: Toward realizing logistics efficiency and optimization for the entire Japanese industry

- In addition to improving productivity in existing logistics operations (transportation, storage, and other physical distribution), CPS utilization will enable efficient transportation by controlling logistics operations by industry and across industries in cyberspace
- While efforts are currently being made on an industry-by-industry and region-by-region basis, future consideration is being given to data linkage across industries and regions, which will lead to greater efficiency in logistics as a whole
  - On the other hand, it is assumed that there will remain areas that require coordination among industries and individual responses, and areas that require human resources

Expected uses of CPS in logistics

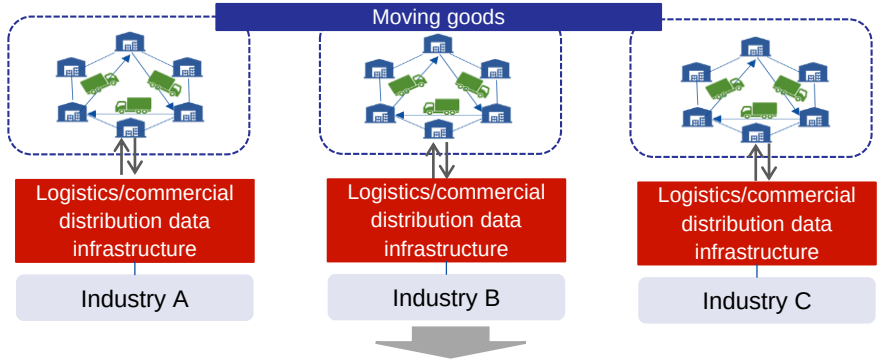
- **Excerpt from Comprehensive Logistics Policy Outline (FY2021-FY2025)**
  - Construct logistics/commercial distribution data infrastructure and promote societal implementation



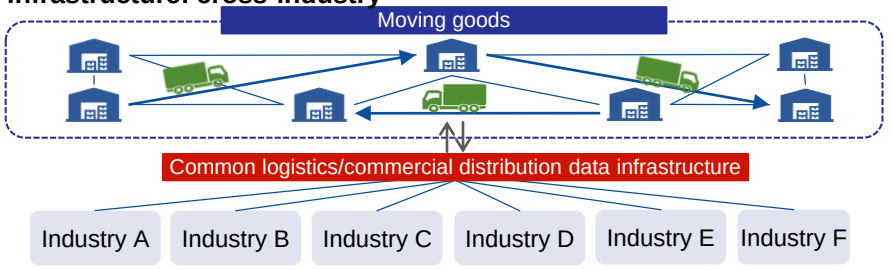
Source: Compiled by Mizuho Bank Industry Research Department based on Ministry of Land, Infrastructure, Transport and Tourism materials

Direction of CPS utilization

Short-term advancements in logistics/commercial distribution data infrastructure: by industry



Envisioned future logistics/commercial distribution data infrastructure: cross-industry



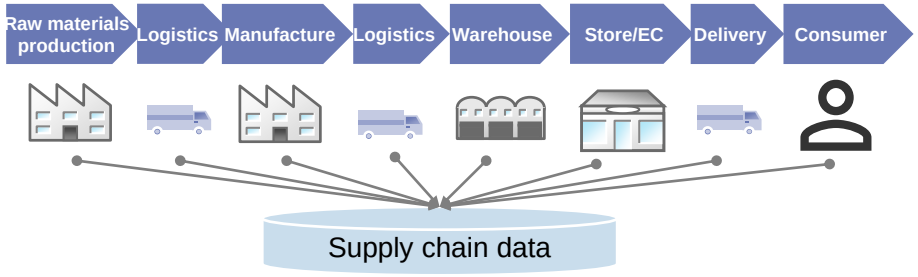
At every stage, it will be necessary to differentiate between competitive and cooperative areas, and to make adjustments for each shipper

Source: Compiled by Mizuho Bank Industry Research Department

Inbound consumption case: Making it possible to reduce costs and enhance brand value

- In the distribution structure for consumer goods, many inefficiencies and waste exist in the supply chain because multiple companies in conflict with each other are individually pursuing the optimal flows of goods. If data linkages among companies progresses and is accompanied by CPS implementation, then it will be possible to construct an overall optimal distribution structure through simulation and analysis of the flow of goods throughout the supply chain, enabling sustained low-cost, high-quality product competitiveness
- Improved metaverse convenience, lower device prices, and network effects are increasing the number of people active in virtual spaces, and creating an environment that can aim for improving the recognition of unique Japanese brands, such as content, history, culture, and design, and for expanding core fan bases

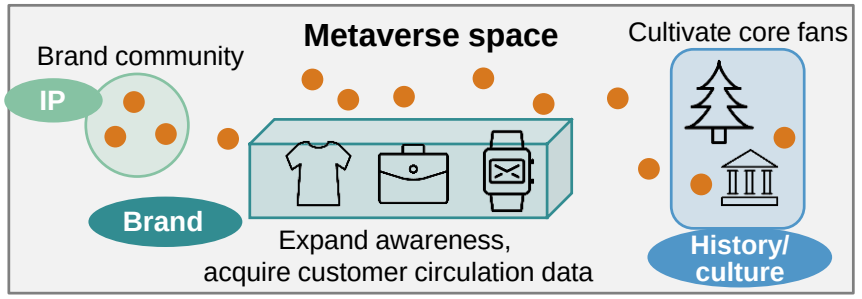
Thoroughly improving efficiency by fully understanding the flow of goods in the supply chain



Data linkages on the supply chain
Optimize flow of goods by performing simulations with CPS

~2030	• Wide-area data linkage in the supply chain is gradually progressing, led by influential players such as major retailers and general trading companies
~2040	• Generate cost reduction effects in the supply chain through analysis and simulation using a wide range of data
~2050	• Change in structure that enables production of low-cost, high-quality goods in a wide range of commercial products

Building brand marketing communities on the metaverse



Improve awareness of Japanese brand products and expand core fan base

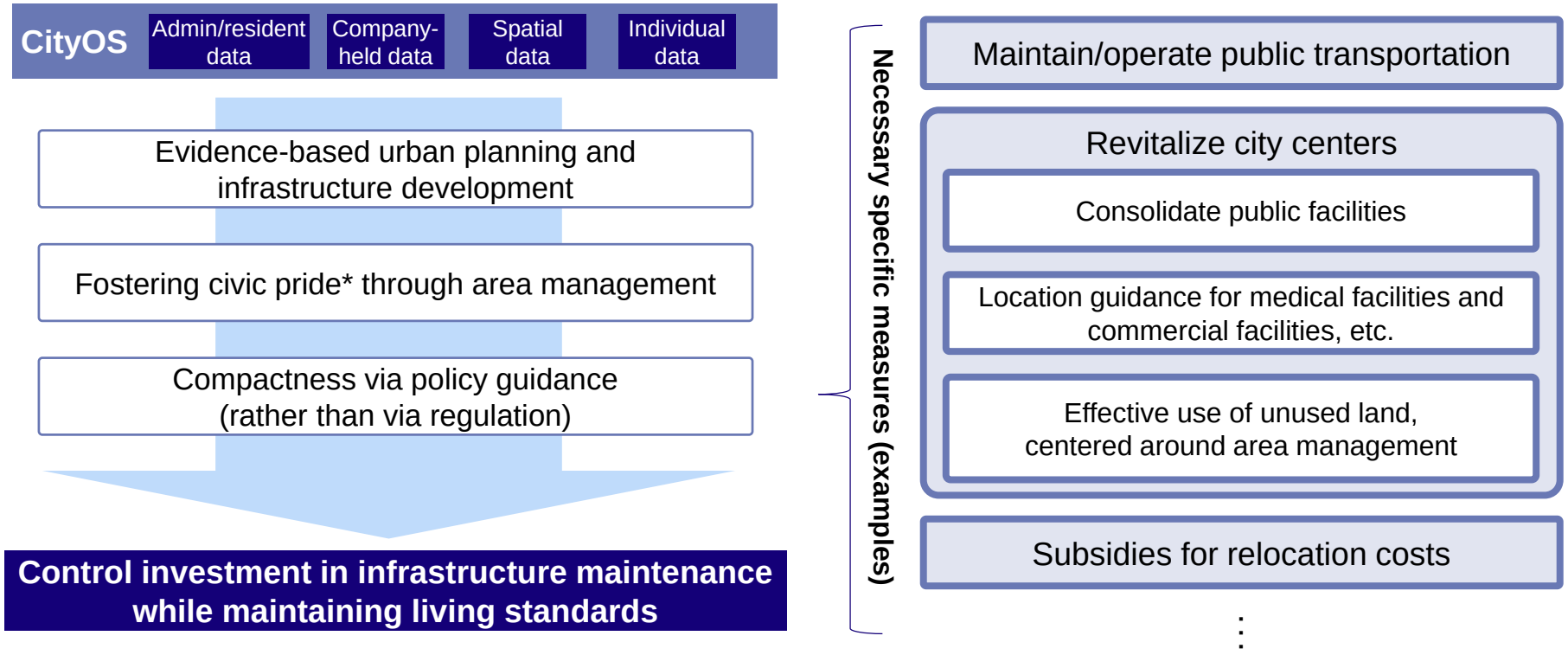
~2030	• Increase in the number of people using the metaverse and spread of corporate use of the Metaverse • Brand advertising and forming fan communities on the metaverse
~2040	• Development of marketing that combines the metaverse and travel to Japan (gamification, use of rank-up systems, etc.)
~2050	• Sales of rare and high value-added products via one-to-one marketing to loyal customers

Source: Both figures were compiled by Mizuho Bank Industry Research Department

Compact city case: Simulation through data utilization contributes to realization

- Enables planning of urban development using data collected in the CityOS. Visualization through simulation fosters understanding of the need for compactness among stakeholders and contributes to the realization of compact cities
- Promotes relocations to city centers by promoting the city center, invigorating public transportation, and attracting facilities/industries. Controls investments in infrastructure maintenance while maintaining living standards

Promote compact cities through policy guidance using data



Note: Pride in the area in which one lives
Source: Compiled by Mizuho Bank Industry Research Department

V. Winning Strategies for Japan and Japanese Industry

1. UX/Contents: The challenge of "eliminating" monozukuri
2. Components: Selling shovels during a gold rush
3. Solving social issues: From an advanced-problems country to an advanced-solutions country

Three winning strategies by combining the strengths of Japanese industry and CPS

Winning Strategies

[UX/Contents]

Provide new value by using CPS as a weapon

- Alongside changes in social structure (focus of consumption shifting to Gen. Z and Gen. α), value is shifting from functions to experiences
- Appeal to decrease negative elements (inconvenience, complexity) and increase positive elements (significance, meaning, enjoyment)

[Components]

Accelerate CPS and grow together

- Support growth markets such as electronic components and functional materials, where demand is expected to increase with the spread of CPS
- At the same time, maintain competitiveness by creating high value-added products through CPS

[Solving social issues]

Transform into an advanced-solutions country via CPS

- Japan is ahead of other countries in global challenges such as aging population, energy and resource conservation, etc. (has accumulated data, know-how, technologies and products)
- Improve the industrial sustainability by solving issues in Japan, and at the same time, spread these successful experience overseas

Strengths of Japanese Industry

[Manufacturing industry]

Monozukuri **<*Suriawase/kaizen* abilities>**

- Quality
- Services
- Trust

Monozukuri **<Industrial clusters>**

- Co-creation
- Research & development
- Human resources

[Non-manufacturing industry]

Inbound **<Highly regarded from overseas>**

- Tourism resources
- Accepting environment
- Product appeal

Specific industries **<Features according to industry characteristics>**

- Content (games, anime)
- Infrastructure (power, communications)
- Service strengths

CPS

Japan's strengths (CPS)

- Inputs: Abundance of real data, advanced sensing technology
- Outputs: Control technologies, products (components, materials)

&

Bolstering the strengths of Japanese industry

- Creating value-added products that will earn for the next generation without relying on “craftsmanship"
- Creating new services that transcend industry boundaries

&

Compensating for weaknesses of Japanese industry

- Eliminating/minimizing issues that hold back growth, such as labor productivity, labor shortages, and passing on skills

Requirements

[Data linkages]

- In addition to optimizing the operations of individual companies, collaboration across companies and industries is the key to maximizing the effectiveness of CPS
- Three points are important: tangible results, psychological safety, and a driving force

Source: Compiled by Mizuho Bank Industry Research Department

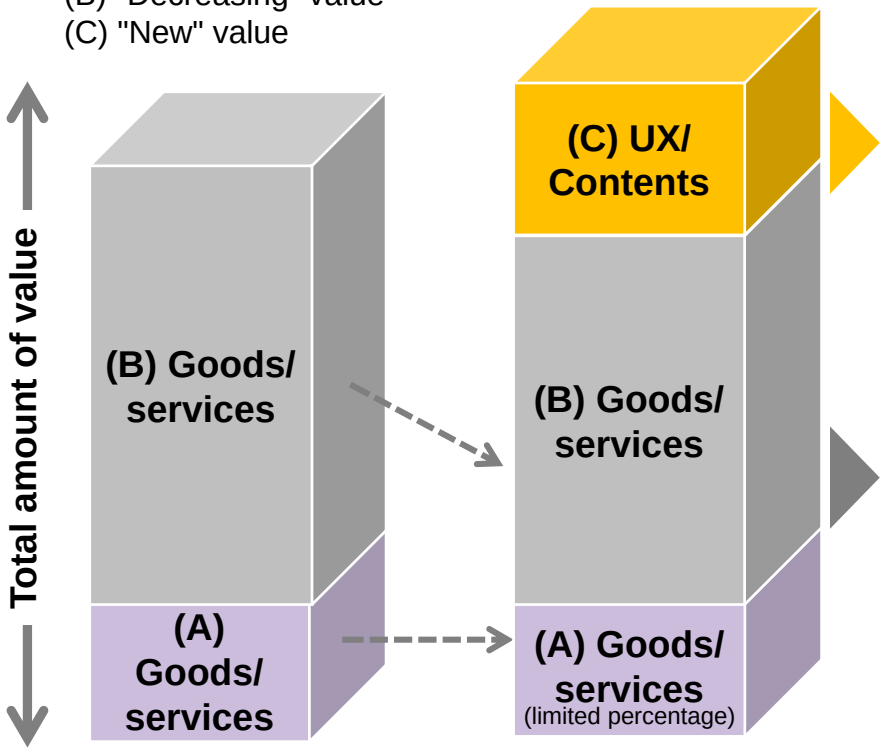
UX/Contents: Shifting from functional value to experiential value

- Traditionally, functionality and ownership were important factors when selecting goods and services, but, as the focus of consumption shifts to Generation Z and Generation α, value is shifting to "experiences"

UX/Contents business concept

The following are expected: (1) increased unit prices due to increased utility of goods and services, (2) new sales of services attached to goods, and (3) increased sales of goods due to services attached to goods

(A) "Unchanging" value
(B) "Decreasing" value
(C) "New" value



<New value for customers to experience>

Personalization	Adjust to user's tastes and preferences ⇒Shift to brands/premium/fans
Content	Spread of XR (VR/AR/MR) ⇒New value by utilizing cyber space
Convenience	Service transcending industry boundaries ⇒ Eliminate complexity and inconvenience

<Value customers have experienced until now>

Functionality	Advances in uniformity and standardization ⇒Functionality is a differentiating factor of the past
Ownership	Increased popularity for subscriptions and sharing ⇒Pleasure from ownership has become even weaker

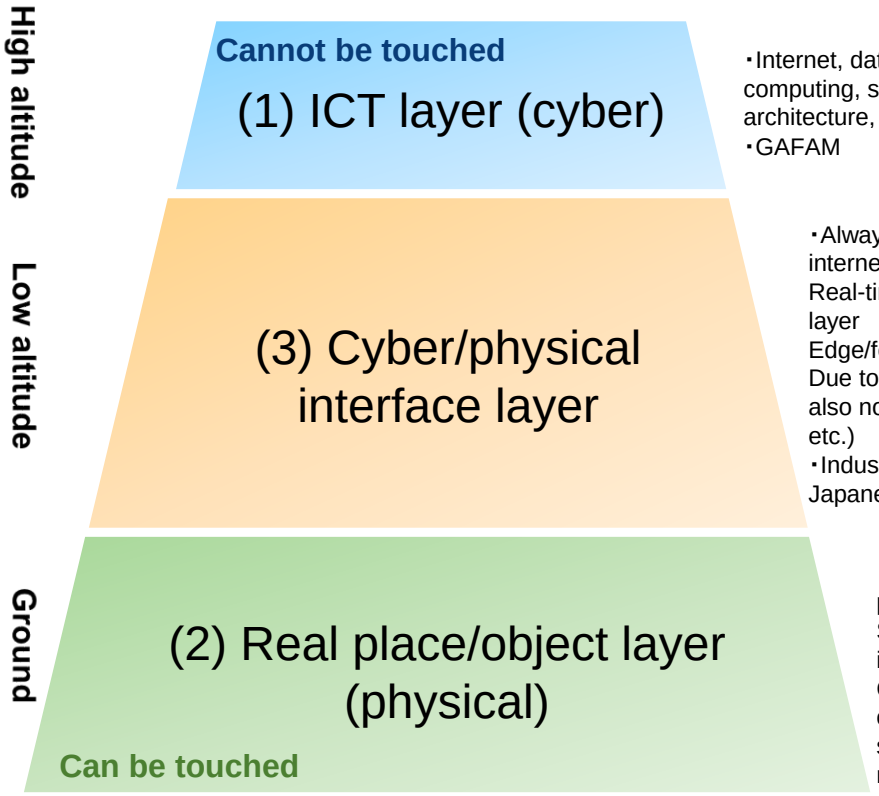
Source: Compiled by Mizuho Bank Industry Research Department

The relationship between goods and services: Quality services come from quality goods

- In order to provide attractive services, outstanding goods are often required, and, by combining quality products and services, it is possible to provide high-quality experience value

Goods and services are complementary, not substitutes

<Analogy: High altitude, low altitude, ground>



・Internet, data center, cloud computing, social network, open architecture, platform competition
・GAFAM

・Always connected to the high-altitude internet
Real-time connection to the ground physical layer
Edge/fog computing
Due to emphasis on real-time, there are also non-internet options (industrial ethernet, etc.)
・Industrial IoT, Industry 4.0, Siemens, GE, Japanese FA companies

・World of material goods; ruled by physical laws
Safety and environmental constraints increase product complexity
Closed architecture, steady product competition, physical equipment, CNC sensors, actuators, traditional manufacturing companies

High altitude / low altitude / ground

- Current digitalization theory tends to place too much emphasis on the (1) high altitude area and neglect the complexity of the (2) physical world on the ground
- On the other hand, it is precisely because some of the goods in (2) are complex that the low altitude area in (3) develops
- Japanese companies need to secure products that cannot be imitated by further building capabilities on the ground, and then establish industry standard interfaces and actively connect with the high-altitude area

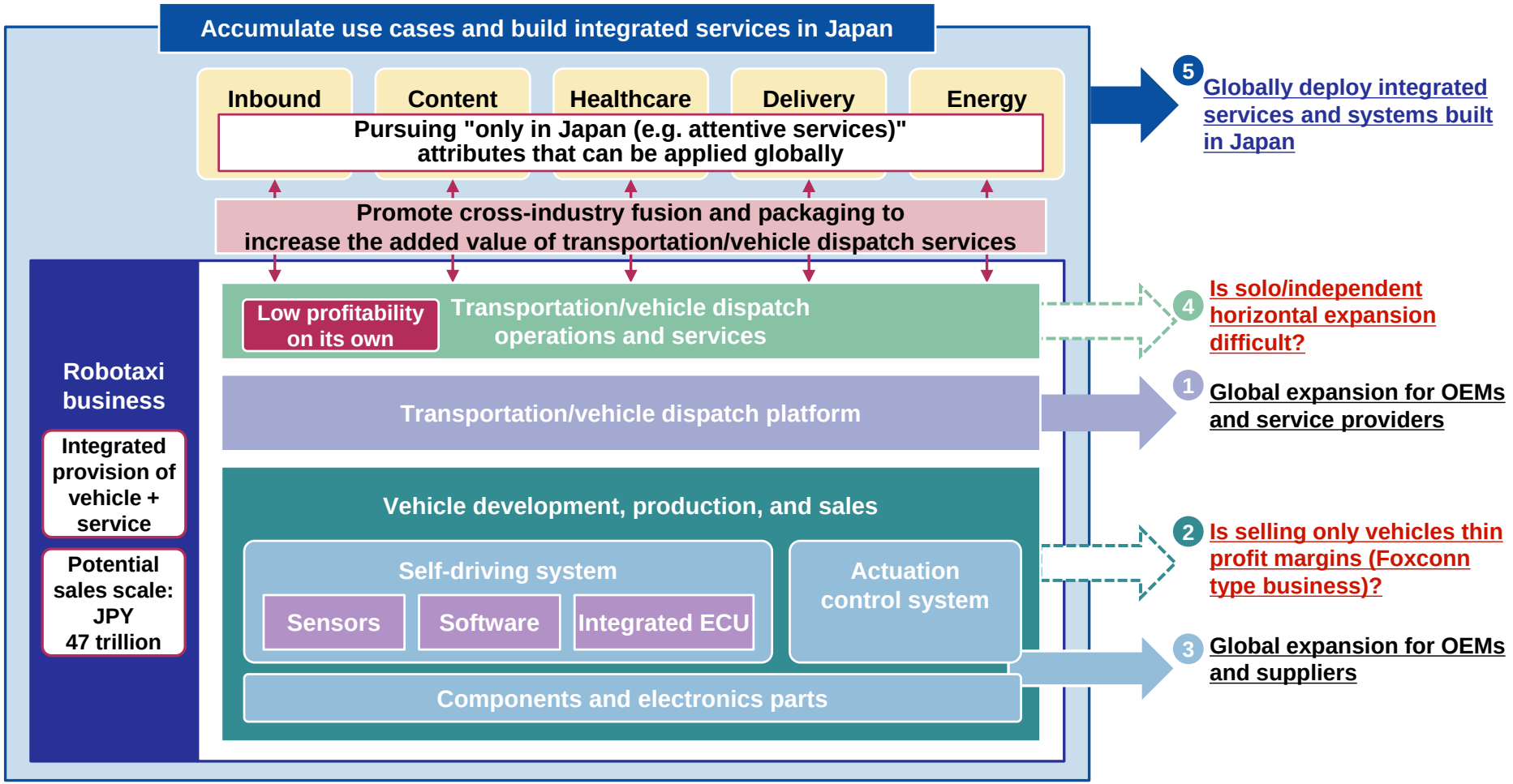
The relationship between goods and services

- In many cases, products and services do not have a substitutive relationship, but rather a complementary relationship; "Concepts are nothing without an object, and objects are nothing without a concept"
  (Example) If a car is manufactured, it is a product, and if the driver drives it for passengers, then it is a service.
- In order to improve the quality of services, it is necessary to improve the quality of manufactured goods (vehicles), the quality of their operation (manual/automated driving), and the quality of the environment/infrastructure

Source: Compiled by Mizuho Bank Industry Research Department based on *White Paper on Manufacturing Industries (Monodzukuri) 2020* (Professor Takahiro Fujimoto, Graduate School of Economics and Manufacturing Management Research Center, University of Tokyo) by the Ministry of Economy, Trade and Industry

Automobile industry: Robotaxi business: Collaboration across industries may lead to high added value

- The profitability of transportation/vehicle dispatch operations and services is expected to be difficult, and the basic route for robotaxi businesses will be to develop services that are integrated with self-driving vehicles
- On the other hand, the horizontal deployment of components such as transportation/vehicle dispatch platforms and autonomous driving systems can be considered, potentially further expanding the fee pool
- Another option is for the automobile industry to play a leading role in promoting industrial fusion and packaging, and to expand overseas with high value-added services originating from Japan

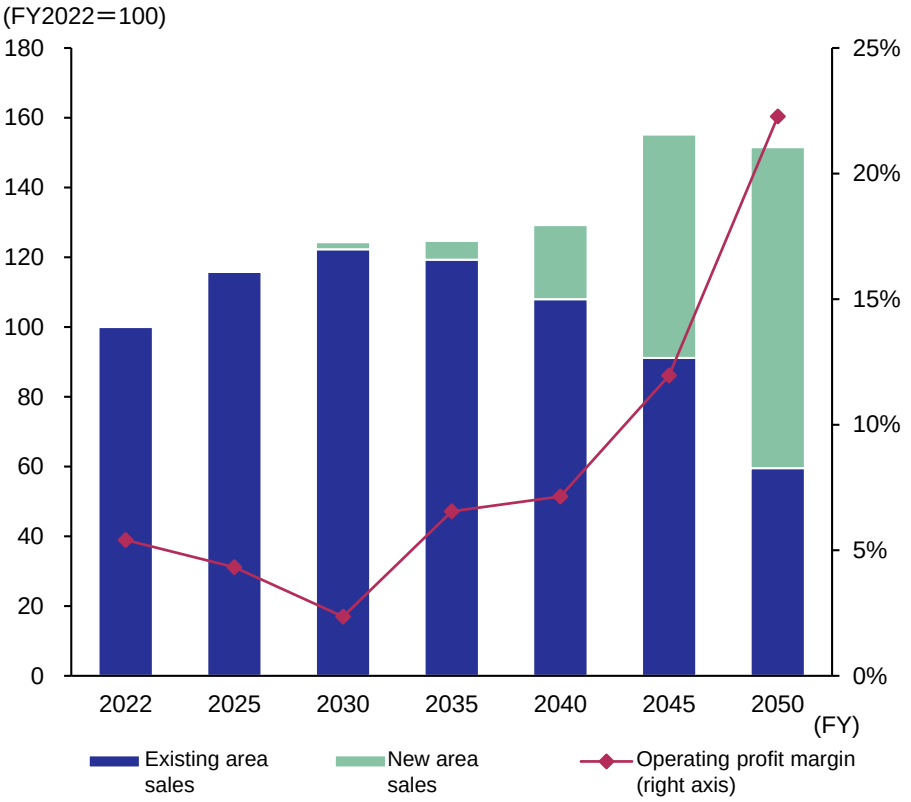


Source: Compiled by Mizuho Bank Industry Research Department

Automobile industry: Need to offset decline in existing business with new businesses toward 2050

- Even around 2035, when their existing business (new car sales and sales finance) will begin to shrink, the scale of the Japanese automobile industry's business should be able to maintain its growth momentum by expanding the stock business in conjunction with the full-scale spread of robotaxis and the increase in the SDV ratio
- Although a temporary decline in operating profit margins is expected at the dawn of the BEV shift and during the start-up period of new stock businesses, over the long term, their operating profit margins are expected to significantly exceed that of existing manufacturing-oriented businesses

Estimation of sales and operating profit margin trends for Japanese OEMs towards 2050



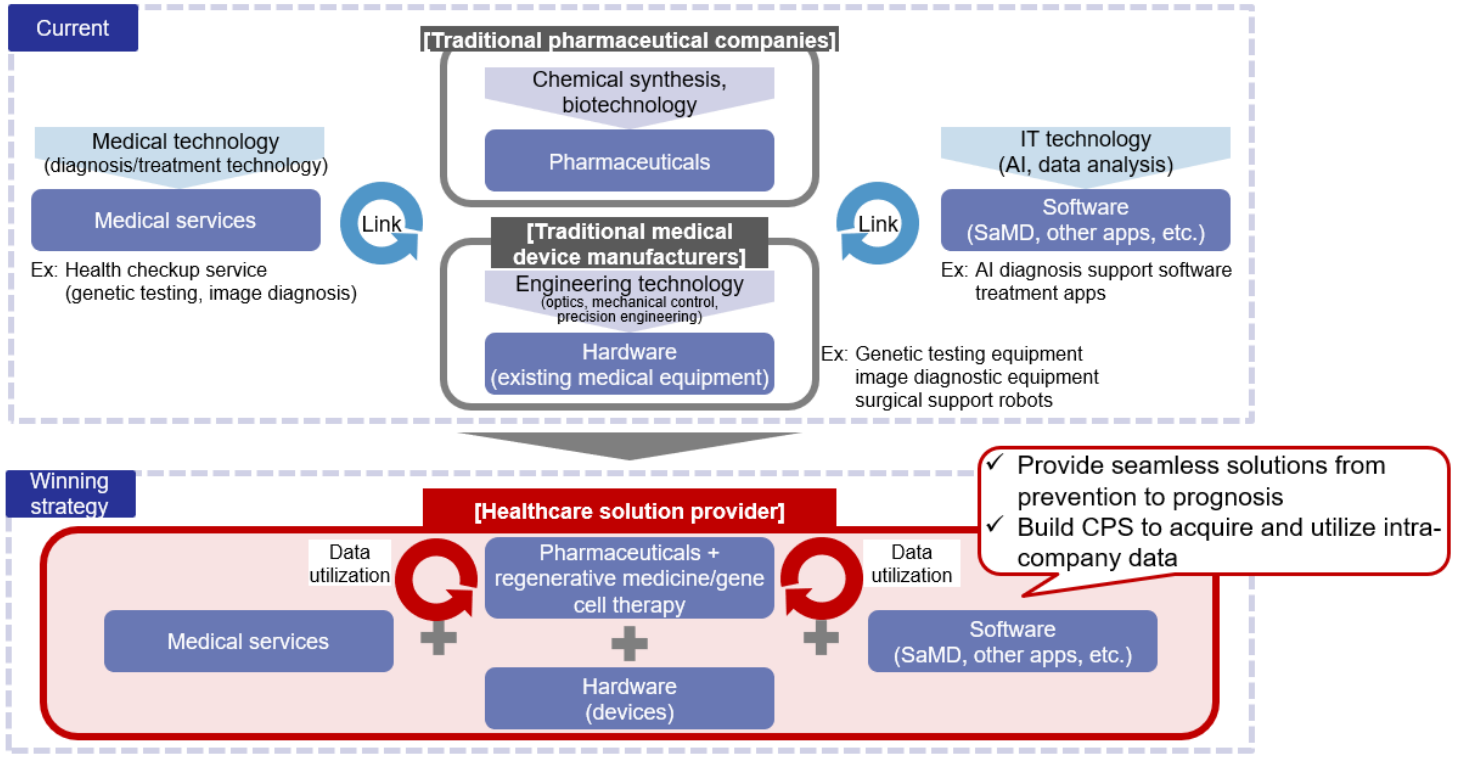
Source: Compiled by Mizuho Bank Industry Research Department based on various companies' IR materials

New areas	Robotaxis	• Full-scale commercialization (revenue recording) after 2036 • Although fares are expected to decline compared to existing taxis, operating profit margin will improve due to lower labor costs
	Added functionality (OTA)	• Will increase with spread of SDV (private vehicles only) • Sales will plateau in the long term as MaaS spreads • Secures high operating profit margin due to business scale
	Content services	• Will increase with spread of SDV • Consists of content for end users (private vehicles) and advertisements for businesses (MaaS vehicles)
	Public charging services	• Increase due to expanded BEV spread • Long term, sales will plateau due to a decline in number of privately owned vehicles
	Power supply/demand adjustment	• Increase due to expanded BEV spread • Long term, sales will plateau due to a decline in number of privately owned vehicles
Existing areas	New car sales Sales finance	• Long-term sales decline due to decline in new car sales • Expanded BEV spread and decreased sales finance will push down operating profit margin in the long term

Medical industry: Transition from manufacturer to healthcare solution provider

- Traditionally, medical device manufacturers have provided high-precision medical devices (hardware) by leveraging their strength in manufacturing technology, while pharmaceutical companies have provided innovative drugs by leveraging their strength in drug discovery
- In a future where data utilization will become increasingly important, in order to maintain and improve the global competitiveness of medical industries, they will be required to transform into healthcare solution providers that provide a wide range of solutions to "support healthcare" across the boundaries of medical devices, pharmaceuticals, regenerative medicine, and medical services, etc.

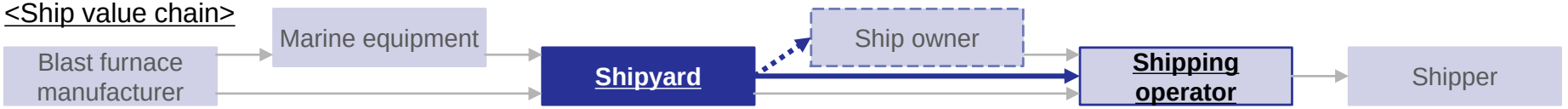
Winning strategies for Japan II: Transforming the medical industry from manufacturer to healthcare solution provider



Source: Compiled by Mizuho Bank Industry Research Department

Shipbuilding industry: Acquiring further added value: Entering the shipping sector

<Ship value chain>



Issue

- ✓ Due to the structure of the industry, the shipping companies (which place the orders) have more bargaining power, and the shipbuilding companies develop and build ships according to the needs of the shipping companies, which deal with the shippers (the final consumers) (≒ shipbuilding companies do not have touch points with shippers)
- ✓ Environmental ships (especially fuel ships) are also subject to environmental regulations, and shipping companies choose the fuel, so shipbuilders work with shipping companies to develop and demonstrate environmental ships
- ✓ The same applies to self-navigating ships, and shipping companies are involved in domestic initiatives

⇒ It is difficult for shipbuilders to form a market by themselves, and it is assumed that they will work in cooperation with shipping companies

Step 1

Involvement in the shipping business, leveraging environmental ship development

- ✓ In response to growing demand for new fuels and energy transportation to realize carbon neutrality, there is potential to expand value-added areas by becoming involved not just in the development and construction of ships, but also in the shipping

It is envisioned that CPS will not be used solely for the purpose of designing and finalizing specifications for the development of next-generation vessels, but also for creating new sources of revenue, for acquiring navigational know-how, and for enhancing touch points with sippers, etc. This area is also expected to see increased added value through the spread of CPS.

<Case study: Kawasaki Heavy Industries' participation in project to transport liquified hydrogen>

- ✓ Japan Suiso Energy (JSE/Kawasaki Heavy Industries: 33.6% stake) and three Japanese shipping companies are collaborating through investment in JSE-Ocean to study by 2024 a marine transportation business scheme that uses the world's first large liquified hydrogen carrier using the world's first large liquefied hydrogen carrier by 2024

⇒ While it is understood that this initiative is not aimed at entering the shipping business, it is an unprecedented initiative and could possibly serve as a catalyst for future business development

Step 2

Commercialization of shipping business for unmanned vessels, etc.

- ✓ Considering the need to increase the presence of Japan's shipbuilding industry, one option is to increase their degree of participation in the shipping sector. It is also important to consider targeting the spread of next-generation fields such as unmanned vessels

Reference / ship owner business

- ✓ Traditionally, some shipbuilding companies have had shipowner companies under their umbrella

⇒ Although there is an asset risk, the purpose is to hedge the high volatility of the shipbuilding industry by placing orders when market conditions are bad (= securing construction volume) and selling when market conditions are good

⇒ If shipbuilding companies' business model changes in the future, then the significance of engaging in the shipowner business may also be changed, as it will be linked: build-own-ship

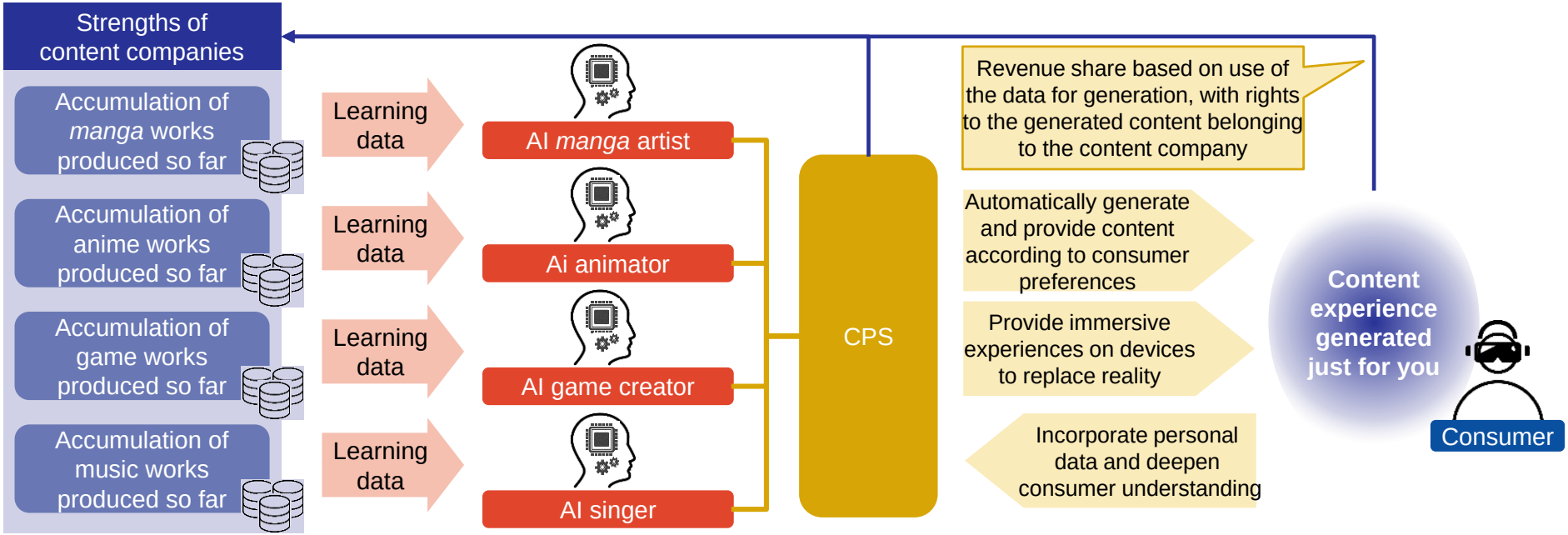
Source: Compiled by Mizuho Bank Industry Research Department based on various published materials

Content industry: Realizing customized content as immersive experiences

- The implementation image of CPS in the content industry is as follows:
  - In order to improve the performance of generative AI, creator AIs will be birthed by taking the large amount of content assets accumulated by content companies int he past and then utilizing it as learning data
  - From a consumer's perspective, CPS not only allows these creator AIs to instantly generate content just for themselves, but also allows them to recreate life-like experiences (such as live music and movies) through their devices, allowing them to enjoy content experiences that are just for you
  - Additionally, because the learning data is copyrighted work, revenue is returned to content companies and creators according to the use of their data, a system is established in which the rights to the new content belong to the companies using the data, and the proportion of licensing businesses will increase

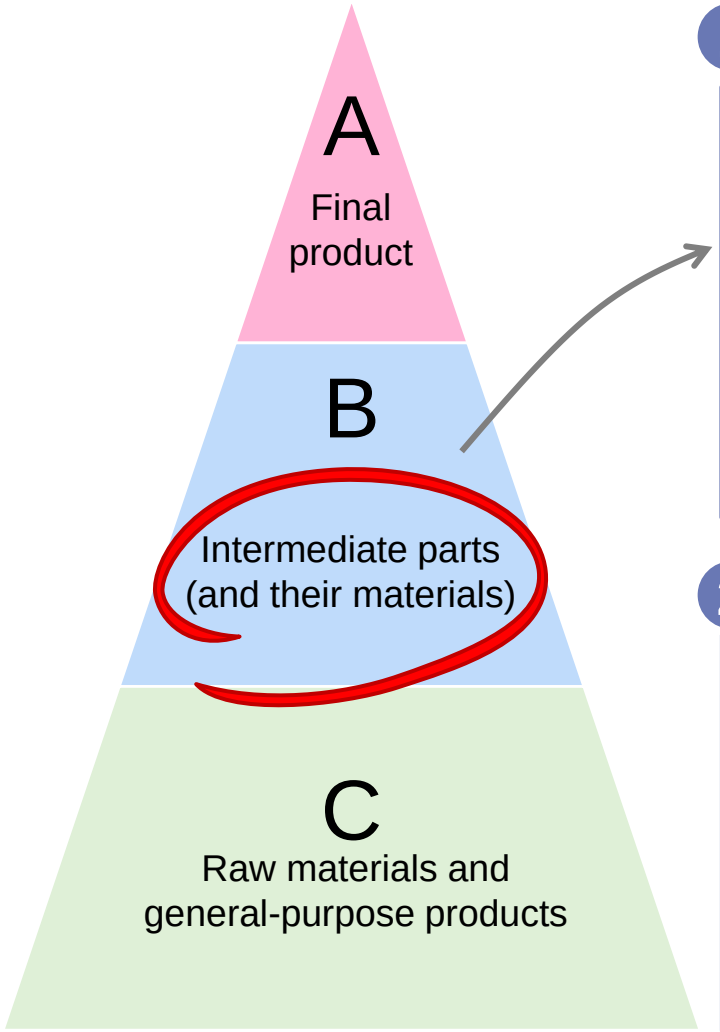
The birth of unique creator AIs that utilize the strengths of content companies and generative AI

Content experiences via CPS implementation



Source: Compiled by Mizuho Bank Industry Research Department

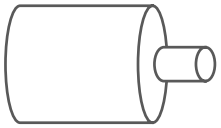
Areas for competing via *monozukuri*: Competing via "XX included" that supports the final product



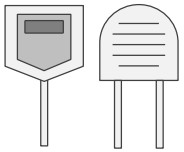
1 Primary intermediate parts / materials composing CPS

Parts

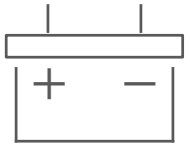
[Motors]



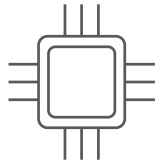
[Sensors]



[Batteries]



[Semiconductors]



Materials

[Thermal properties]	[Electrical properties]	[Mechanical properties]
Thermostability, thermal dissipation, thermal shielding, insulation, etc.	Permittivity, dissipation factor, insulation, resistivity, etc.	Impact resistance, rigidity, tensile strength, etc.

2 Relationship with CPS

Intermediate parts/materials and CPS achieve complementary growth

1	Over the history of the development of Japan's electronics and automotive industries, electronic parts and materials have been established as being in a world-leading position
2	In order to increase CPS utility, it is necessary to quickly and accurately obtain more of the necessary data
3	High-performance and high-quality intermediate parts and materials will support the spread of CPS, and, as demand expands, intermediate parts and materials are expected to grow both quantitatively and qualitatively

Source: Compiled by Mizuho Bank Industry Research Department

Areas for competing via *monozukuri*: Competing via "XX included" that supports the final product

Strengths of intermediate parts (and their materials)

Internal	Original	Proposal
"Secret ingredients" that come from material recipes, equipment with in-house specifications, and processing technologies	"Unshakeable taste" that is not affected by the life cycle trends of end products	"Original recipe" proposals that combine raw materials and parts
Difficult to imitate **High profitability**	**Unaffected by life cycle trends of end products** **Low volatility**	**Difficult to switch to other products** **High switching costs**

<From past history>

- In the past, there have been two major patterns in which Japanese *monozukuri* failed:
  - ① Losing competitive advantages due to overseas manufacturers catching up
  - ② New technologies and business models create markets, and then demand for existing products declines
- Products from Japanese manufactures that are currently maintaining a global presence share the strengths listed on the left

Conditions for maintaining strengths

1 Analog elements remain (must have)

Digital ("0" and "1") products can be easily replicated, so ambiguity in raw materials and manufacturing processes (analog elements) is the key

2 Market size barrier (better to have)

When breaking down products and technologies, a market size that is "not too large" is an invisible shield that prevents new entrants from entering the market

- In the future, digital utilization will make disassembly, analysis, and development of similar products easier than before
- The key to maintaining the "secret sauce" and "original recipe" is to leave no room for complete analysis

Source: Compiled by Mizuho Bank Industry Research Department

Electronics industry: Constructing systems, infrastructure, and *monozukuri* PF

- For Japanese electronics companies, the winning strategies are constructing systems (sensor/actuator supply), infrastructure (evolution and supply of electronic components and semiconductors), and *monozukuri* PF to increase the scope for added value via CPS

The winning strategies for Japanese electronics companies lie in constructing systems, infrastructure, and monozukuri PF

Layer	Overview	Image	Added value direction	Electronics winning strategy
Application	✓ Various industries utilizing cyber-physical systems	Manufacturing: Elec-tronics, Auto-mobiles, Industrial machinery, Aircraft, Ships, Materials; Non-manufacturing: Resources, Content, IT, Retail, Distribution/food, Medical care	✓ Impact will differ depending on each industry's response	**Constructing a monozukuri platform that faithfully and at the right timing physically realizes the user-requested designs and plans** → Constructing PF
Cyber	✓ Digital space composed mainly of software that reproduces the physical layer or that is generated independently of the physical layer	Cyber Physical System: ✓ Recognition, processing, and determinations of input data ✓ Generate maps of phenomena in physical layer ✓ Generate content ✓ Processing required to control actuation	✓ Demand for software creation and implementation of each function listed on the left	
System	✓ Hardware and software layer that connects the physical and cyber layers	Sensors / Actuators	✓ Increase in number of devices required to construct systems	**Sensor and actuator supply** → Constructing systems
Physical	✓ Space where physical phenomenon occur, primarily composed of hardware		✓ Changes in response to increasing role of the cyber layer	
Infra-structure	✓ Foundation in terms of hardware, software, and technology to support cyber-physical systems	Server storage; Communications infrastructure (base stations, low orbit satellites, etc.); Computing (quantum, (generative) AI, security, etc.)	✓ Increase in number of devices required to construct systems	**Evolution and supply of electronics components and semiconductors (components, modules)** → Constructing infrastructure

Source: Compiled by Mizuho Bank Industry Research Department

Electronics industry: Players need skills that suit their layer

- It is important for electronics components / semiconductor players to strengthen their materials and to expand and enhance their products lineups in accordance with the products they offer
  - Finished product players also have an opportunity to build a *monozukuri* PF that includes the upstream supply chain

Player	A. Strengthen internalization by incorporating materials	B. Expand lineup of electronics components and semiconductors	C. Construct a delivery optimization system
Electronic components / semiconductors (common)	✓ Internalize and digitize necessary materials information (element properties and composition, composition process, and equipment designs, etc.)	✓ Expand and enhance product lineup beyond electronics components/semiconductor categories ✓ Make more difficult to imitate via to modularization of various electronic components and semiconductors	✓ Internalize and digitize the "movement of goods" in the physical layer, from material procurement to delivery to users (incl. supply chain of finished products)
Sensors	✓ Internalize and digitize material layers for highly accurate sensing	✓ Expand and enhance sensor lineup for sensing various physical phenomena in physical layer ✓ Strengthen software that integrates sensors	It is now possible to construct a delivery optimization system by linking electronics components/ semiconductors and finished products
Actuators	✓ Internalize and digitize material (magnetic and ferrous/non-ferrous) layers for highly accurate actuation	✓ Expand and enhance motor lineup to provide various types of feedback to physical layer ✓ Strengthen software that controls motors	
Passive components / Connector components / Semiconductors	✓ Strengthen material layers that lead to improved performance of various passive components, connector components, and semiconductors required in the infrastructure layer	✓ Expand and enhance lineup of various passive components, connector components, and semiconductors required in the infrastructure layer	
Finished products			✓ Internalize and digitize the "movement of goods" in the physical layer, from material procurement to delivery to users (incl. supply chain of electronics components and semiconductors)

Monozukuri system

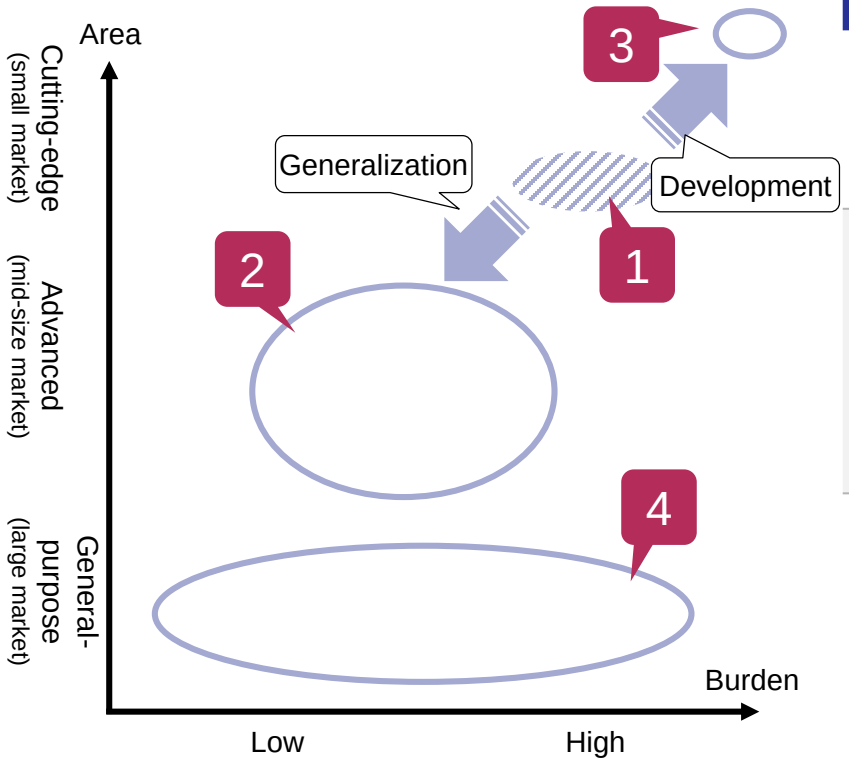
Three winning strategies	(1) System: Sensor and actuator supply	(2) Infrastructure: Evolve and supply electronic components and semiconductors (components, modules)	(3) Construct a *monozukuri* PF

Source: Compiled by Mizuho Bank Industry Research Department

Chemical industry: Winning strategies that fully utilize CPS: Utilization as both an offensive and defensive tool

- (1) Cutting-edge and (3) ultra-cutting-edge: Utilize CPS as a defensive tool that complements retaining and securing engineers, and as an offensive tool to accelerate research and development
- (2) Cutting-edge to general-purpose: Utilize CPS as an offensive tool to reduce the burden of *suriawase* and *tsukurikomi* while also increasing production capacity
- (4) General-purpose: Increase seller negotiating power through reorganization and personnel reallocation, and utilize CPS as an offensive tool to compete with non-Japanese companies

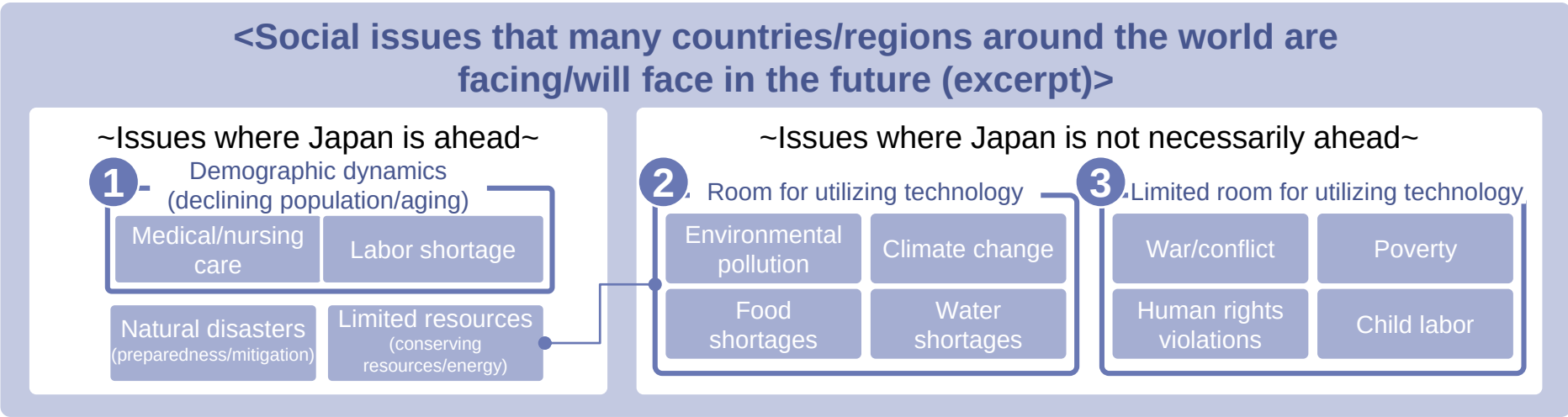
Areas to go on the offense (repost) and winning strategies



No.	Area	Main competition	How to maintain superior positioning/ overcome inferior position?
1, 3	Cutting-edge, ultra-cutting-edge Superior position	Japanese companies and European/US companies	• Utilize CPS as a defensive tool to complement retaining and securing engineers, and as an offensive tool to accelerate research and development in collaboration with customers. Also expected to be used as a tool to identify areas in which a company can win
2	Cutting-edge to general-purpose Inferior position	Emerging countries	• Utilize CPS as a defensive tool to create cost competitiveness by improving suriawase efficiency via data linkages with customers, and by reducing tsukurikomi burden on employees via manufacturing automation, etc. • Expand production capacity based on market conditions. If a company will not be built up/reinforced, then it will be important to consider selling to a competitor as soon as possible
4	General-purpose Inferior position	Emerging countries and Japanese companies	• Utilize CPS as an offensive tool to compete with non-Japanese companies by making timely and appropriate investments and business strategy decisions based on sophisticated analysis of market conditions, by refining SCM (SC risk management and CO_2 management), and by automating manufacturing • Aim to increase profitability by realizing environmental value after improving seller negotiating power through reorganization and personnel reallocation

Source: Compiled by Mizuho Bank Industry Research Department

Transitioning from an advanced-problems country to an advanced-solutions country



1 Bringing Japan's successful experiences to the world

- Japan leads in experience, know-how, and technology. In many cases, Japan is a leader only in terms of the issues, but not in terms of the solutions. However, there are many opportunities for demonstration and implementation, and Japan has the potential to establish "winning patterns" before other countries

2 Business opportunities in the name of SDGs

- Japan, a "have-not country," has a long history of improving its resource and energy conservation efforts. There are many star candidates, such as recycling, water treatment, and next-generation energy (on the other hand, there are also high hurdles to overcome due to economic and technological factors)

3 Perennial issues since the dawn of history

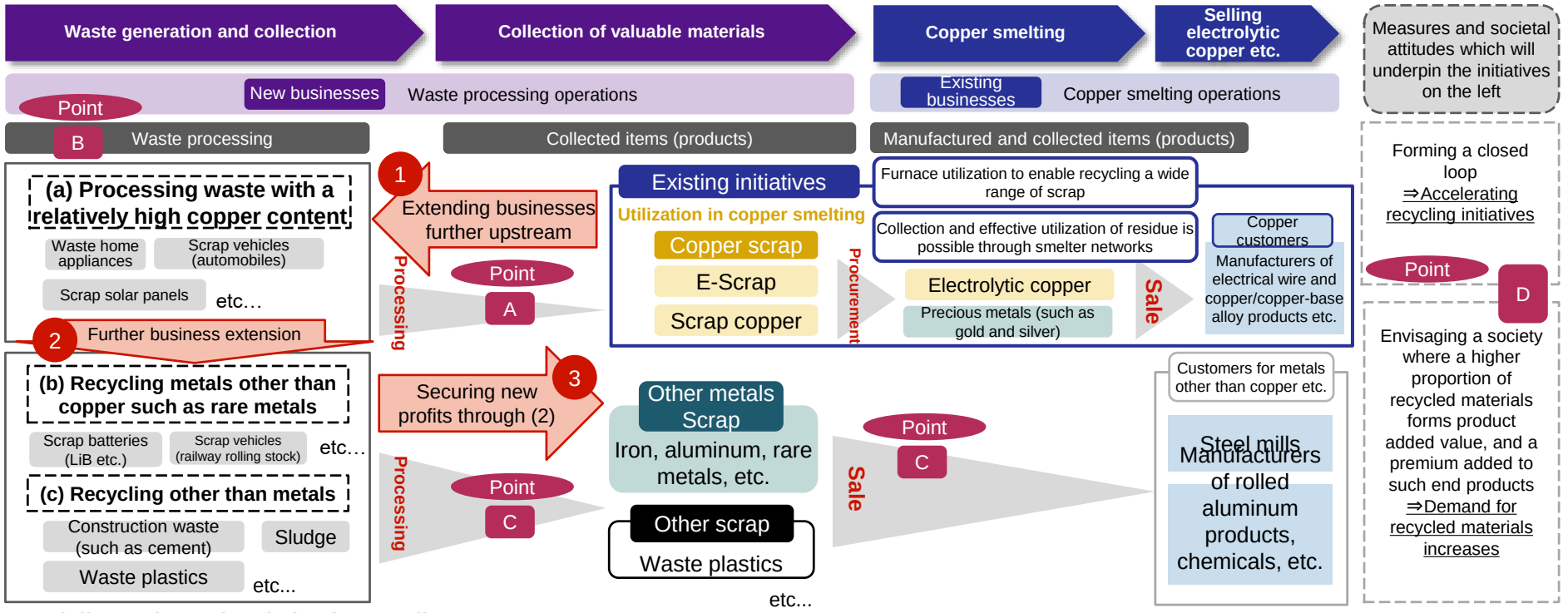
- Issues that have existed throughout human history. There is limited room for using technology to solve these problems
- For businesses, these areas aren't looked at from the perspective of solving the problem, but rather are defined as markets, such as military or BOP

Source: Compiled by Mizuho Bank Industry Research Department based on publicly available information

Non-Ferrous Metals Industry: Transitioning to comprehensive recycling companies

- In the short term, focusing on processing waste with a high copper content and collection of copper scrap to secure raw materials for copper smelting businesses and collect/sell precious metals. In the long term, achieve transformation into comprehensive recycling companies by initiatives to process and recycle metals other than copper and a wide range of waste - not limited to metals - to create greater diversity in sources of income

Initiatives concept diagram



Focal discussion points in business rollout

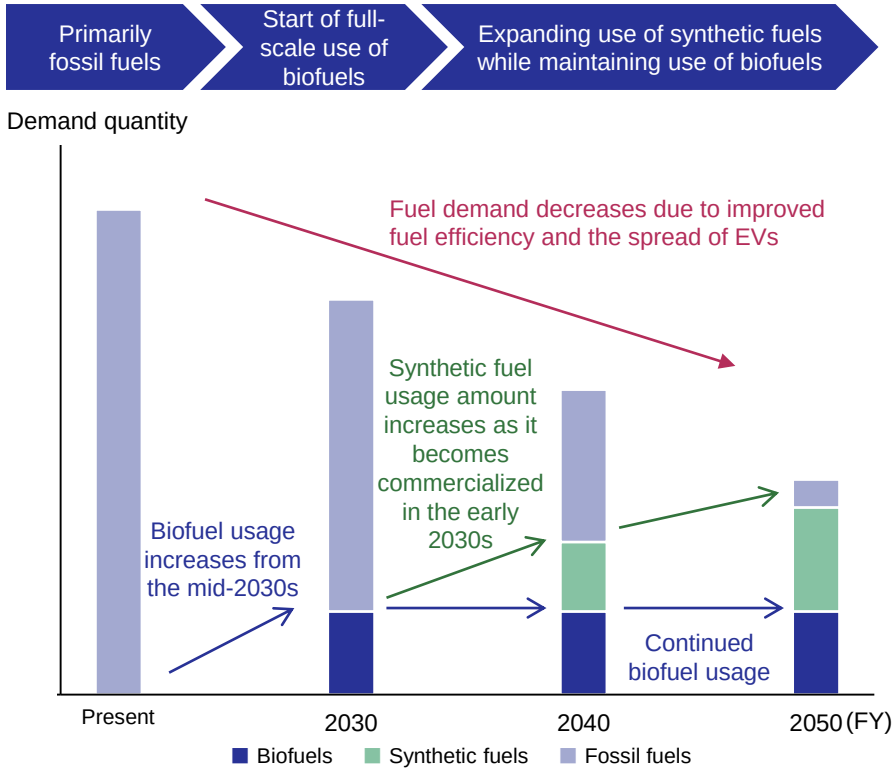
A	Strengthening procurement of copper scrap for utilization in copper smelting through entry into the waste processing business (utilization of CPS also increases the usable volume of copper scrap)	B	Beginning with operations processing waste with a relatively high copper content (order is a→b→c) (it is anticipated that sector entry for processing waste other than metals will take time)
C	Securing new sources of profit (waste processing income, scrap sales income)	D	Promoting the transition to comprehensive recycling companies

Sources: Compiled by Mizuho Bank Industry Research Department based on various materials

Petroleum industry: Image of the spread of CN liquid fuels and necessary initiatives

- For low-carbon and carbon-neutral liquid fuels, it is assumed that biofuels will be used a bridge in the short- to medium-term and that synthetic fuels will be widely used in the long-term
- In order to promote their widespread use, it is necessary to have early plant start-up and to verify combustion performance, to clarify their environmental value, and to secure "rights and interests"

Image of shift to CN liquid fuels (Mizuho hypothesis)



Necessary initiatives for promoting spread

1 Early plant start-up, and verifying combustion performance

- Currently, the supply of CN fuels is low, so it is necessary to start up production plants as soon as possible
- CN fuels also have a different composition from fossil fuels, and it is unknown if they will have adverse effects on equipment that use them
- Oil wholesalers and automobile manufacturers must collaborate to verify combustion performance and collect data

2 Clarifying environmental value

- CN fuels are more costly than conventional fossil fuels, and thus allocating their environmental value is important
- It is necessary to establish a system for certifying environmental value and allocating that value, as well as a mechanism for beneficiary payments, such as allocating environmental value using a mass balance method during the transition period

3 Securing "rights and interests"

- In order to mass product CN fuels, it is essential to cheaply secure large quantities of the raw materials (used cooking oil and ethanol for biofuels, and hydrogen and CO_2 for synthetic fuels)
- It is desirable to regard raw materials as new "rights and interests" both domestically and internationally, and to actively invest in bio-resources and hydrogen resources

Note 1: Demand quantity is for illustrative purposes
Note 2: Mizuho Bank Industry Research Department forecast from 2030 onwards
Source: Compiled by Mizuho Bank Industry Research Department

Source: Compiled by Mizuho Bank Industry Research Department

Robotics industry: Prediction that autonomously-driven robots will appear in the world of 2050

- Current robots ("conventional robots") can only accurately operate under conditions where their target, environment, and task are predetermined
- In the world of 2050, autonomously-driven robots ("future robots") that recognize their surrounding environment and make decisions/actions according to the situation are expected to appear
  - However, because the development costs of future robots will be higher than those for conventional robots, it will be important to expand sales of conventional robots in order to raise funds for development costs

Comparison between conventional robots and future robots

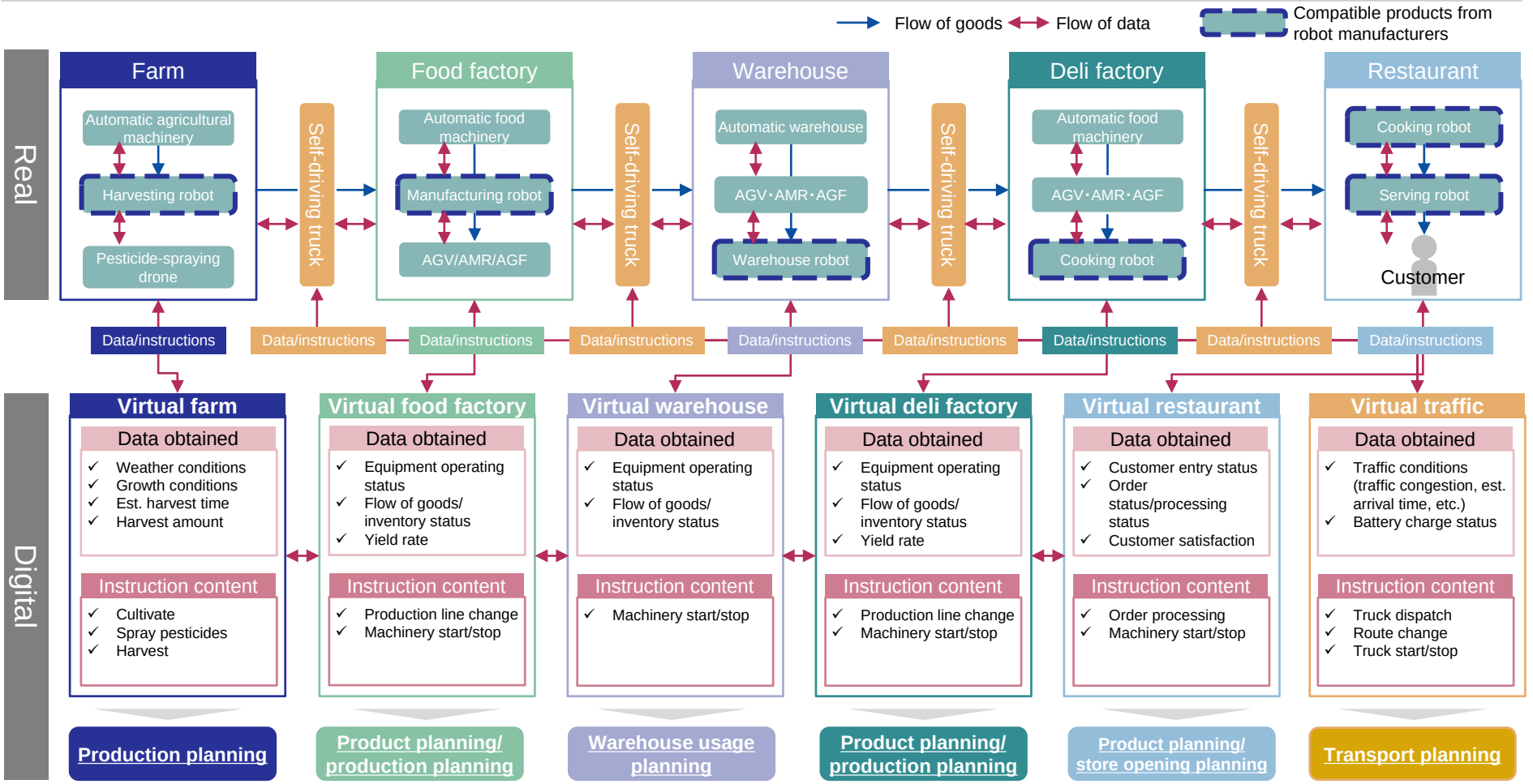
	Conventional	Future	
Classification	Industrial	Industrial	Service
Users	Automobiles, electronics, etc.	**(in addition to items on the left) Food, pharmaceuticals, cosmetics, logistics, etc.**	**Medical/nursing care, etc.**
Environment	Fixed environment	**Environment that may change**	
Target	Goods (solids)	**Goods (incl. flexible items)**	**People**
Function	Single-function / works as instructed	**Multi-function / flexibly operates depending on situation**	**Single and multi-function / flexibly operates depending on the situation**
Robot development cost	Low	**Medium**	**High**

Source: Compiled by Mizuho Bank Industry Research Department

Robotics industry: World-view after CPS implementation (example of value chain in restaurant industry)

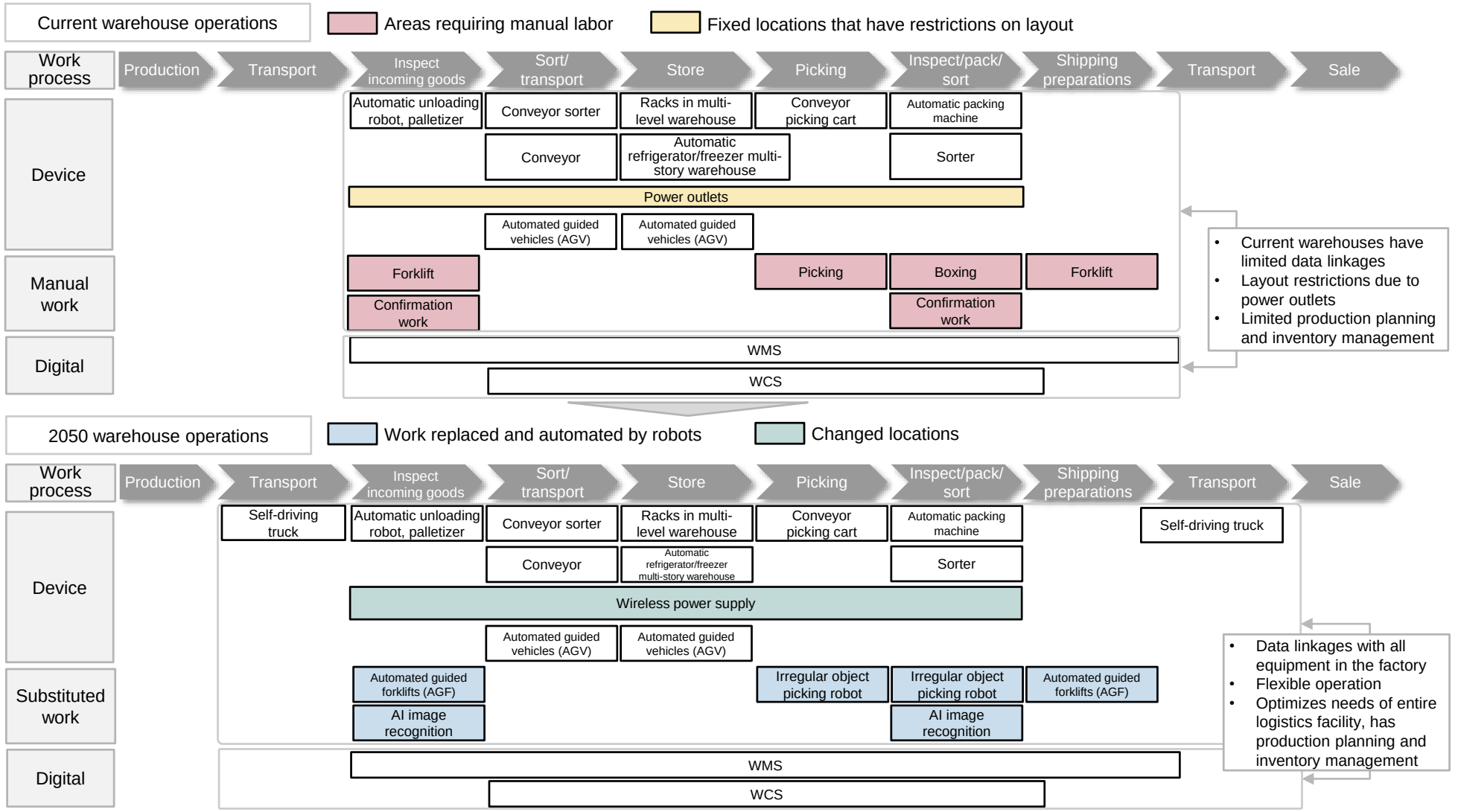
- By utilizing data obtained within the value chain, it will be possible to plan and change not only equipment controls, but commercial/manufactured product planning and production according to the situation

Example of a worldview where CPS has been implemented (value chain from farm to restaurant)



Source: Compiled by Mizuho Bank Industry Research Department

Material handling industry: Connected and automated equipment enables completely unmanned warehouses



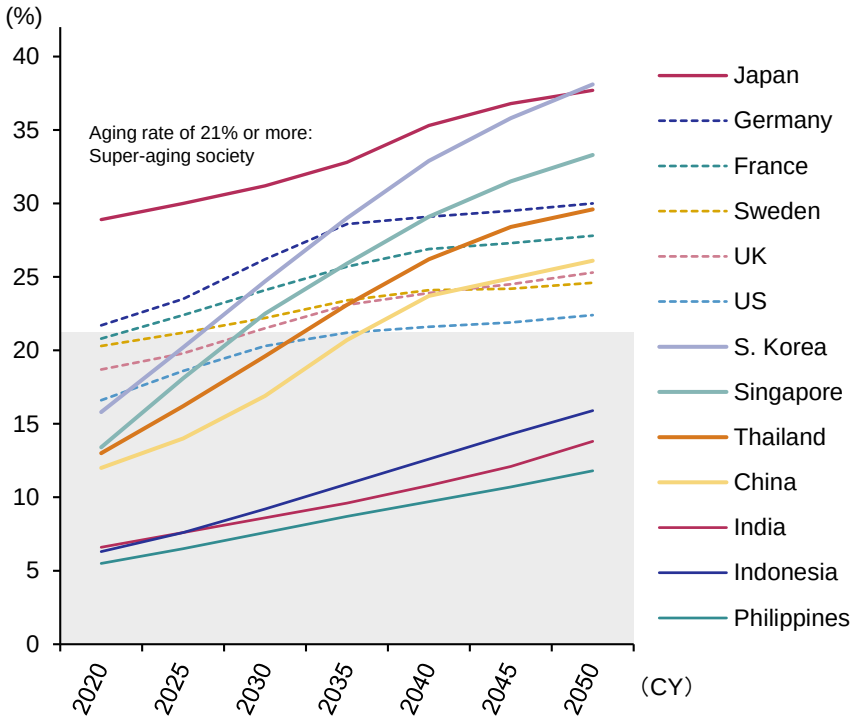
Note: WMS = Warehouse Management System, and WCS = Warehouse Control System. WMS refers to a system that can manage incoming and outgoing goods and inventory within a warehouse. WCS, on the other hand, can control material handling equipment and IoT equipment

Source: Compiled by Mizuho Bank Industry Research Department

As an advanced country with an aging population, Japan is considering building an ecosystem focused on aging

- One idea is to pursue strengths in specific disease areas. By taking advantage of the fact that Japan has the highest aging rate in the world as of 2020, in the 25 years until 2050 Japan can build a database that no other country will have, such as a biobank focused on dementia and aging, and by doing so can consider becoming a research and development field for healthcare solutions aimed at the increase in super-aging societies, primarily in Asia
- In doing so, the use of highly sensitive health data would be permitted only for entities with business locations in Japan, thereby increasing incentives for research and development in Japan and attracting/accumulating innovative companies and related parties both from within Japan and overseas

Forecast aging rate trends in major countries



Source: Compiled by Mizuho Bank Industry Research Department based on *Global Population Prospects* by the United Nations

Prior example of biobank specializing in the field of geriatric diseases

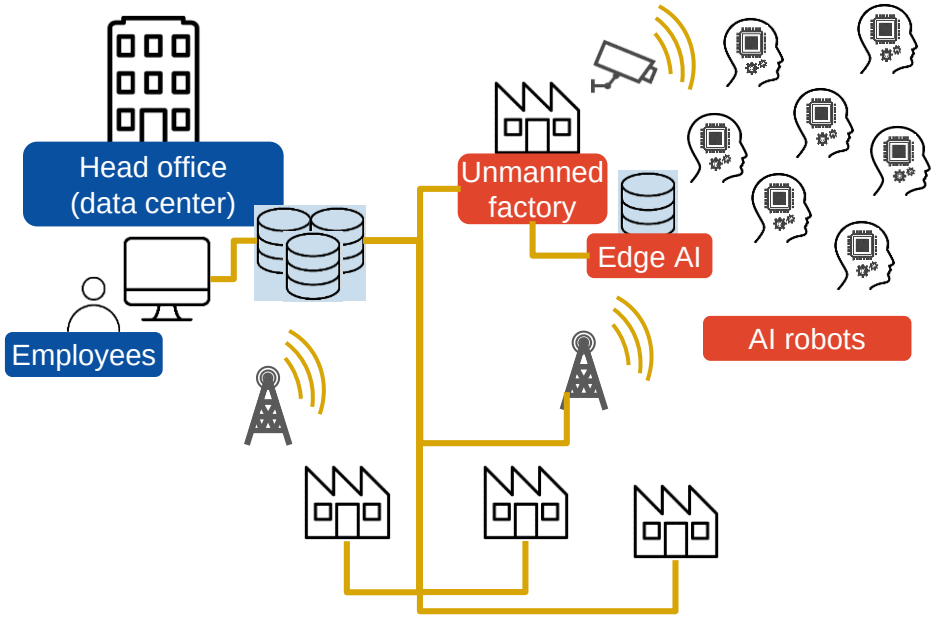
National Center for Geriatrics and Gerontology Biobank	
Overview/ features	• Japan's only biobank specializing in the field of geriatric diseases; contributes to research on dementia, etc., which is a concern in an aging society • Also accumulates various omics analysis information, including patient genome analysis information for dementia and bone and joint diseases, which are particularly closely related to aging • Samples and information from healthy elderly people participating in cohort studies targeting local residents are also deposited in the biobank and can be distributed to third-party medical research
Sample type	Blood-derived DNA/serum/plasma/tissue/cerebrospinal fluid, etc.
Sample information	Sample storage information, as well as various medical information/genome information about the donor, etc.
No. of stored samples	Total number of registrants: 12,277 people / Total number of samples: 44,021 samples (as of the end of March 2023)
Disease name	Dementia and bone/joint diseases, etc.

Source: Compiled by Mizuho Bank Industry Research Department based on the National Center for Geriatrics and Gerontology website

Expectations for the early creation of use cases by leveraging the strengths of Japan's telecommunications infrastructure

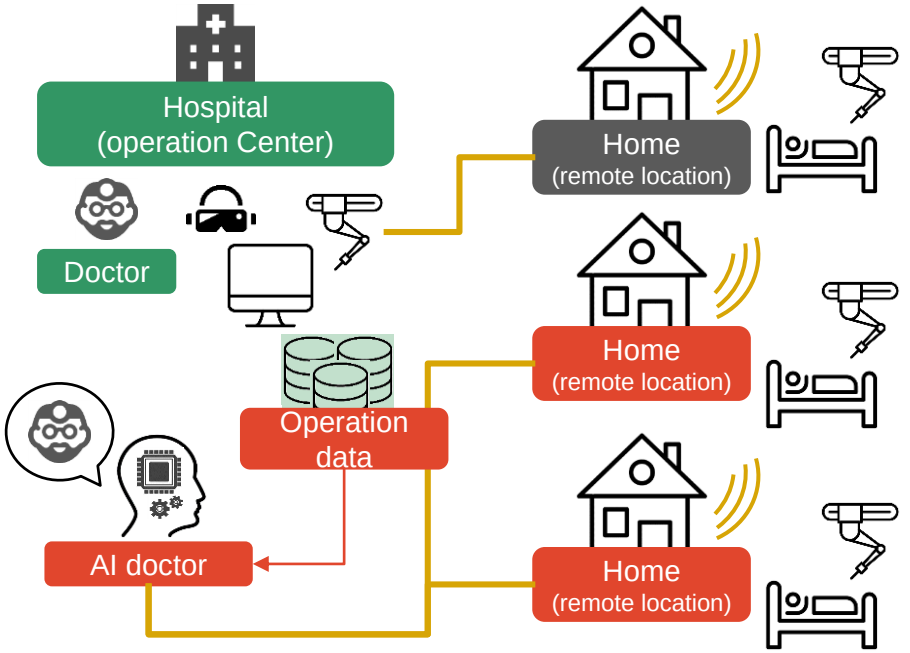
- Use cases (draft) based on communications development are as follows
  - Through collaboration with other industries, use cases that utilize communications should be quickly created. Japan should then solve the social issues and export the use cases at the same time

Draft use case to solve labor shortages in Japan



Employees at the head office centrally manage the behavior of AI robots in scattered factories, thereby making the factories completely unmanned. To solve the worker shortage in the Japanese manufacturing industry, the majority of the robots' actions are controlled autonomously by the edge AI, not by the head office

Draft use case to solve uneven distribution of doctors in Japan



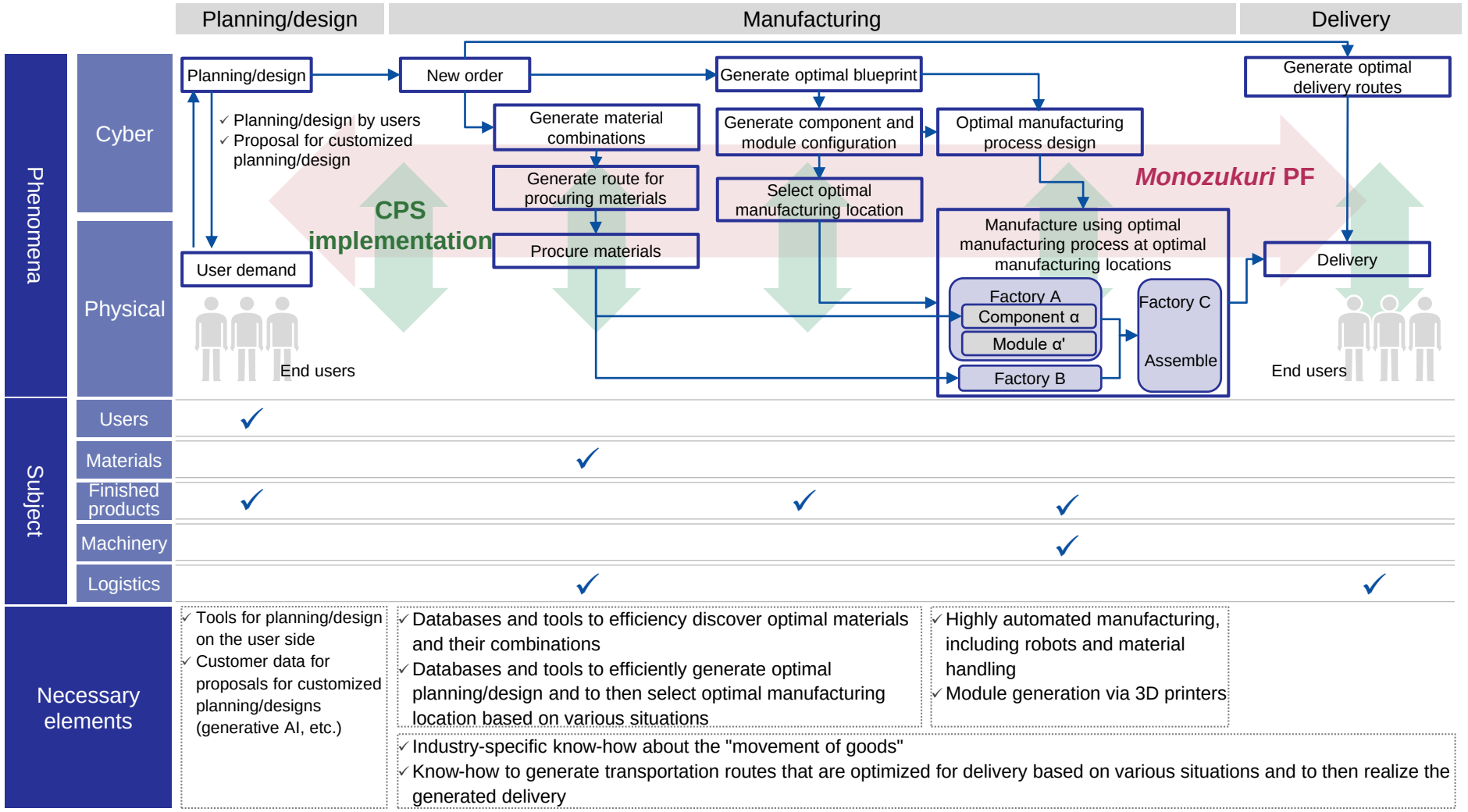
CPS enables medical patients to receive medical services and surgeries equivalent to those in hospitals from the comfort of their homes (remote locations). Accumulating this operation data and having AI learn from it will also enable doctors to reform their work styles

Source: Both figures were compiled by Mizuho Bank Industry Research Department

As CPS implementations evolve, cross-industry collaborations will become a differentiating factor

- As CPS implementations progress in various layers, it will become difficult to achieve differentiation by using solely intra-industry strategies

Collaborations across industries will enable the creation of *monozukuri* platforms (PF)



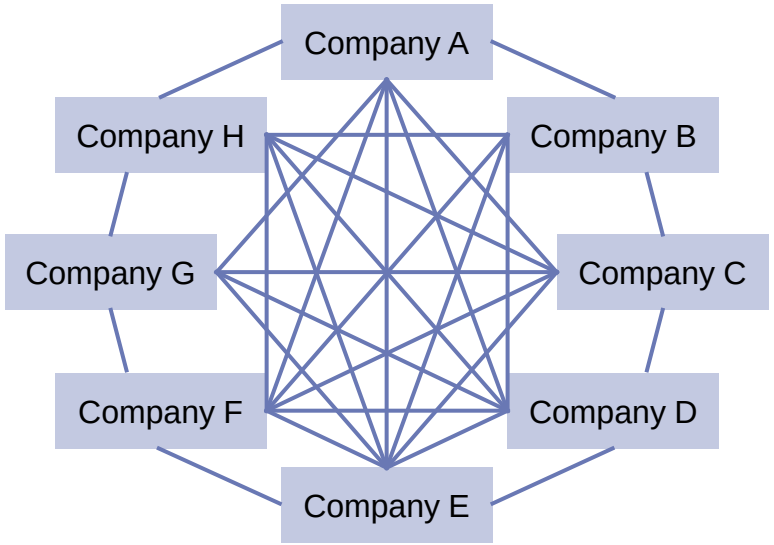
Source: Compiled by Mizuho Bank Industry Research Department

Issues for maximizing utility: Data linkages across companies and industries

- Although CPS can be used to optimize individual companies, its true value lies in overall optimization via data linkages across companies and industries
- On the other hand, there are a variety of barriers to these kinds of data linkages, such as competitive relationships, legal restrictions, and the avoidance of excessive proximity to specific customers

Expectations for and difficulties with network effects

[Metcalfe's Law]
The value of a network is proportional to the square of the number of users connected to the system.

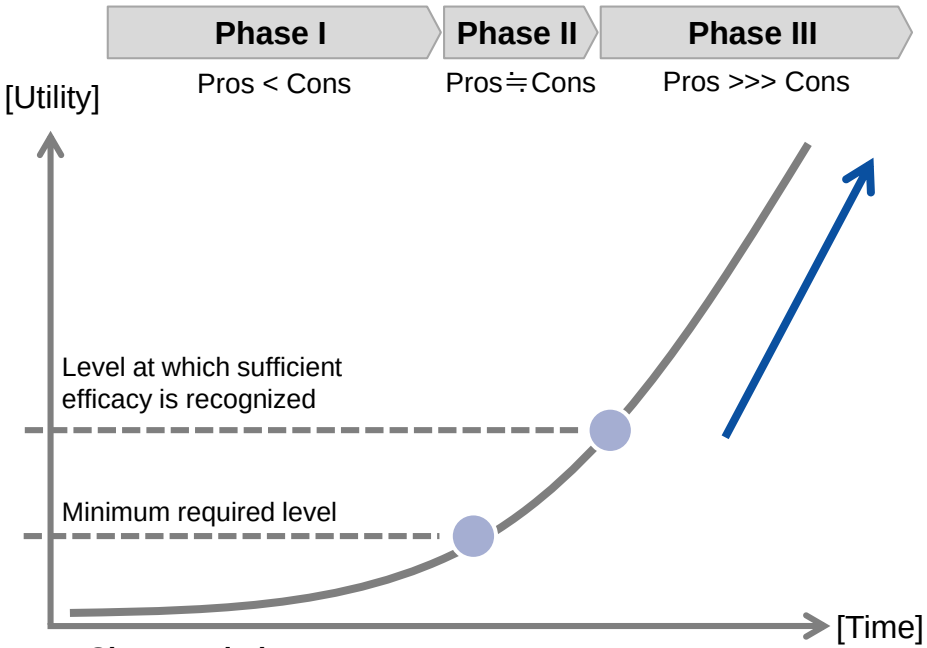


<Factors that impede data linkages (examples)>

Competitive relationship	Conflict of interest	Legal restrictions
Need for contract	Trust relationship	Security

Source: Compiled by Mizuho Bank Industry Research Department based on publicly available information

The utility gained by participating companies increases exponentially



<Characteristics>

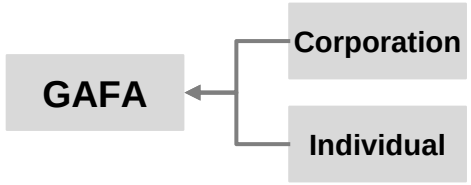
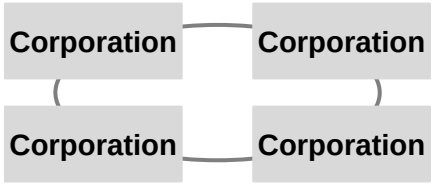
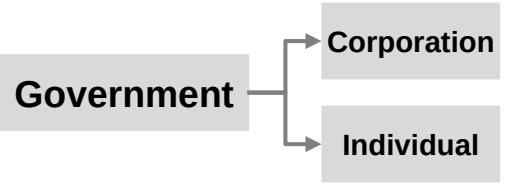
1. A considerable amount of time is required before a certain degree of effect can be recognized
2. Once the advantages and disadvantages start to balance out, the effects can suddenly accelerate
3. Utility exponentially increases after the expected level is exceeded

Source: Compiled by Mizuho Bank Industry Research Department

National/regional approaches to data linkages

- In the US, the private sector is leading the way, and in Europe, the public and private sectors are working together to build data infrastructure. In China, on the other hand, there is coercive, government-led siphoning off of data and the promotion of mutual use

Differences in approach between the US, Europe, and China

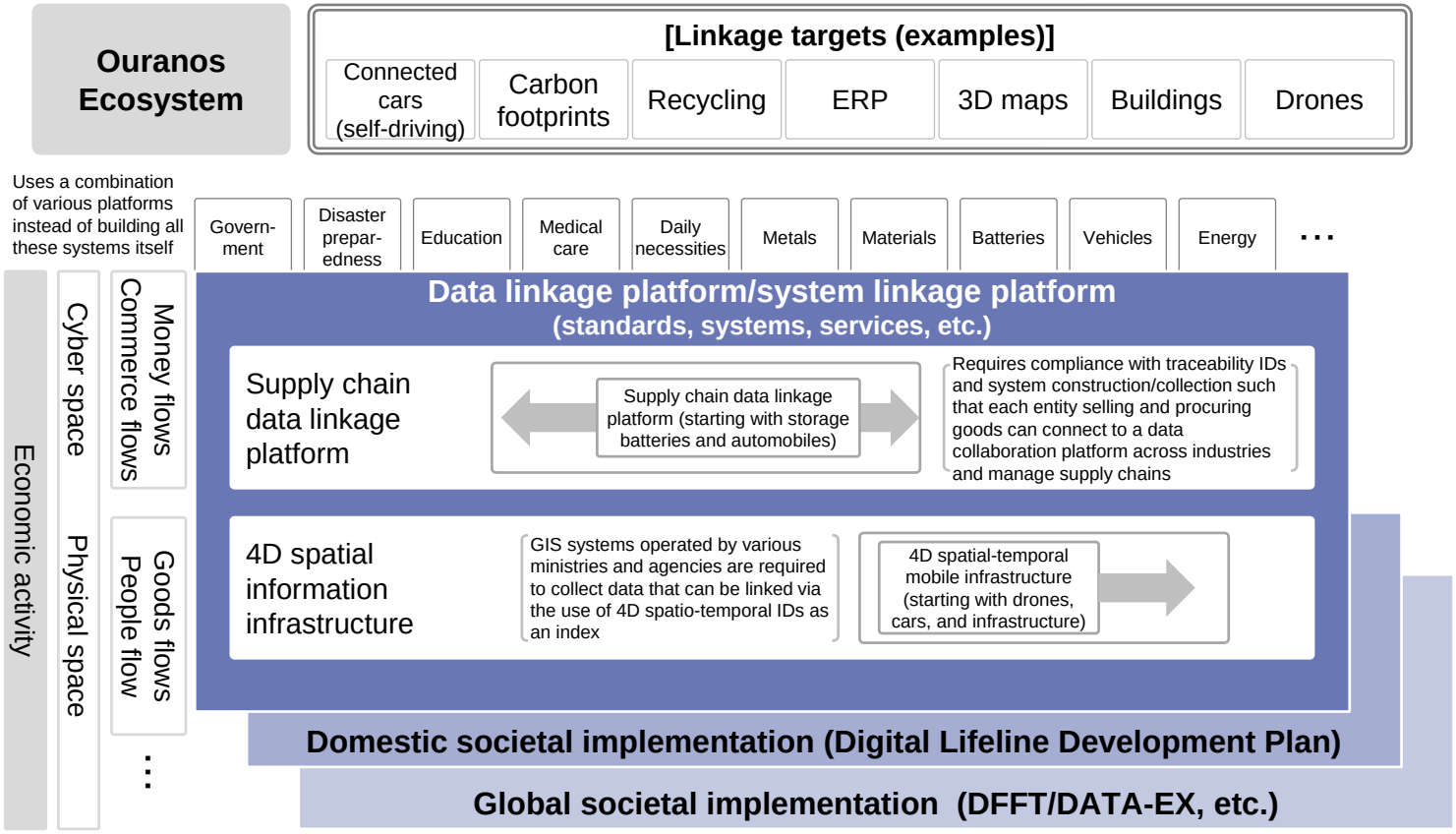
US	Europe	China
Strong private enterprise platforms	Platform that connects industries	State-led and top-down
GAFA	**GAIA-X (from 2019)**	**National Data Administration (from 2023)**
☐ Specific large companies collect data and use it for marketing, etc., to achieve sustainable growth and high profitability ☐ Closed utilization of data from individuals and corporations (including those in different industries) within a platform built by the company	☐ The EU plans to regain data sovereignty by constructing its own data infrastructure and avoiding data leaks via the CLOUD Act from the US ☐ Focus is on data protection and transparency. Integrates various cloud services, etc. on a single system, breaks away from the dependence on the US and China, and realizes data sharing and exchanges between companies	☐ The following roles were transferred from the Office of the Central Cyberspace Affairs Commission and the National Development and Reform Commission: • Building data-related basic systems, integrating and sharing data resources, and constructing digital infrastructure ☐ The government will take the lead in promoting data utilization through promoting data interconnections and interoperability between industries
		

Source: Compiled by Mizuho Bank Industry Research Department based on publicly available information

Japan's approach to data linkages: The Ouranos Ecosystem

- The Ouranos Ecosystem aims to promote participation by domestic companies and to coordinate interoperability with overseas data linkage initiatives (to prevent Galapagosization), as well as to promote research and development, demonstration, societal implementation, and dissemination of data sharing mechanisms via industry-government-academia collaborations.

Overview of the Ouranos Ecosystem



Ecosystem for organizations and human resources

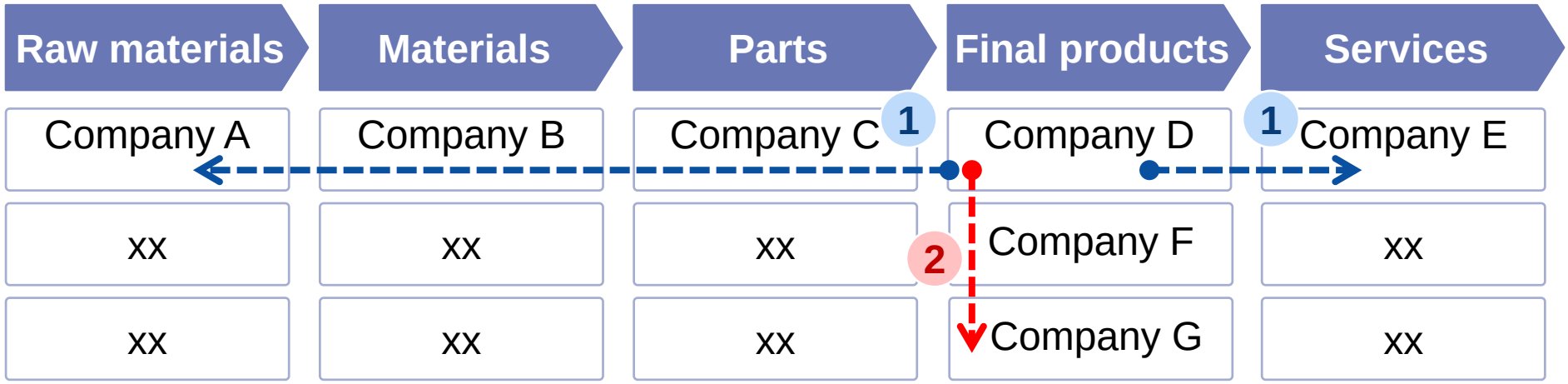
- In addition to the government, the network will be built by bringing together organizations and human resources such as user companies, startups, universities, industry groups, and IT vendors
- A "mission" and "place" will be provided to create an environment for "quickly proposing prototypes" and "obtaining feedback from the user side"

Ecosystem for systems

- Certifying and authenticating system will ensure safety, reliability, and interoperability, and will create a future framework that will enable mutual connections

Source: Compiled by Mizuho Bank Industry Research Department based on Ministry of Economy, Trade and Industry materials

How to move forward with data linkages: (1) Supply chains, and (2) Accumulating successful experiences with competitors



Accumulation of know-how from successful experiences

[1] Linkages with upstream and downstream companies

[2] Linkages with competitors

- Data standardization/compatibility
- Arranging contractual relationships
- Managing data quality
- Ensuring security

Selecting core areas

- It is necessary to draw a line between core areas where information should not be shared and areas where value can be expected to be maximized through co-creation with other companies
- Towards the above, visualize strengths and weaknesses based on internal and external environments such as market trends, product share, and patents

First-mover benefits

- Expected benefits (example)
  - Cost reduction effects due to optimizing various operations such as inventory and delivery
  - Close co-development that shares data in real time
- Disadvantages of not linking (example)
  - Prioritizing orders to inner circle companies
  - Reluctance to doing business with companies that do not disclose data, etc.

Source: Compiled by Mizuho Bank Industry Research Department

"Winning" and "losing" data linkage patterns

	"Winning" data linkage patterns	"Losing" data linkage patterns
Effect	☐ Participants have a common understanding of the specific benefits (goal image) that is shared at the outset ☐ Enjoy the benefits of improved efficiency and the creation of new knowledge through active data exchanges among participants. ☐ The development of AI and other technologies is a prerequisite for the realization of these benefits.	☐ Participants have mixed objectives. Limited effectiveness due to the presence of companies that aim to become freeloaders and companies making decisions on a case-by-case basis ☐ Unable to achieve expected outputs due to insufficient data quantity/quality
Cost	☐ Infrastructure development costs will be incurred, including data preparation, contract signing, and security measures ☐ Aim to minimize initial cost burden by starting small and then growing large. Naturally, effects will be greater if starting large, but, in many cases, decision-making costs outweigh the effects	☐ Infrastructure construction costs are incurred, such as data maintenance, contract signing, and security measures ☐ Aim is to maximize effects by starting with a large group of industries, but costs are too high
Psychological safety	☐ Establish a mechanism where data ownership remains with the data originator by using a clearing organization (data deletion) or tokens when data is exchanged ☐ Psychological safety is gradually established, and the scope of data sharing is expanded	☐ Reluctance to provide data because of suspicions that customers or competitors might analyze their strengths when they hand over data ☐ Other companies are aware of the trends amongst participating companies and are pulled in by the above trends
Driving force	☐ Industry leaders and highly cognizant business owners will spontaneously promote friendships/partner forming, thereby expanding the "circle of friends" ☐ Participants gather in the name of "the reasons why we have to do it," such as legal compliance or environmental regulations	☐ If one or more core business operators are absent, then no one will be willing to take the initiative, resulting in sluggish growth in the number of participants

Three key points: (1) Tangible results (materials for determining cost-effectiveness), (2) Ensuring psychological safety, and (3) Existence of a driving force

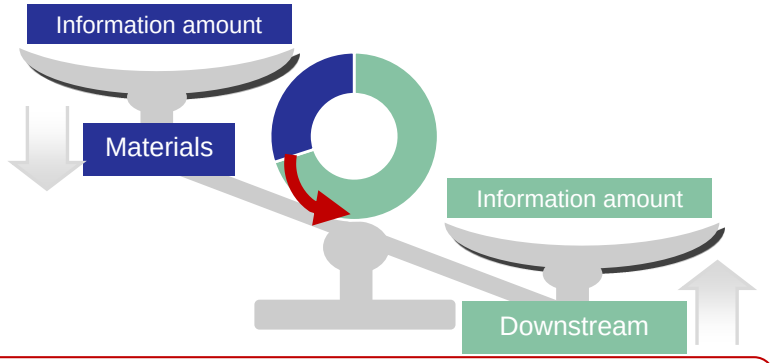
Source: Compiled by Mizuho Bank Industry Research Department

(1) Tangible results: New value created via data linkages

- Elimination of information asymmetries via data linkages may be seen as allowing the transfer of added value from downstream to materials, and may be viewed with reluctance
  - Promote the fact that industry problems can be solved via attraction and linkages via the data platform linkage that provides a variety of information

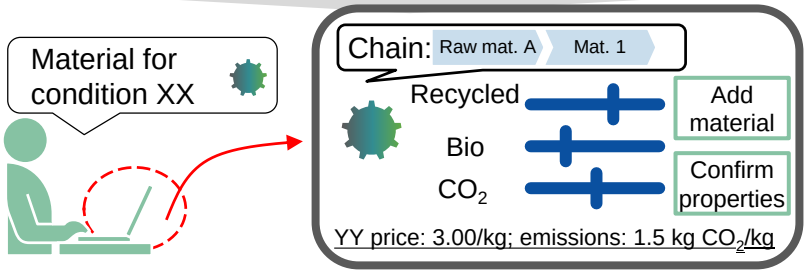
Concerns brought about by eliminating information asymmetries, and proposed approaches to resolving them

Data linkages change information asymmetry



As the number of high value-added proposals from the materials side increases, there is a possibility that companies will show a reluctance to data linkages due to concerns about the transfer of a portion of their profits

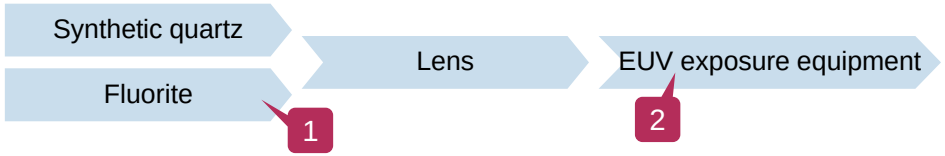
How to draw them into data linkage platforms?



Centrally manage the information customers need and provide it on the data linkage platform

Benefits of downstream data collection + CPS utilization (Mizuho hypothesis)

Case study: EUV exposure equipment supply chain and issues (lens-related only)



No.	Issue	Benefits of data linkages + CPS
1	• The huge lenses installed in EUV exposure equipment require high-quality fluorite, and are currently dependent on China	• Possibility of finding production methods that can reduce the amount of fluorite used, as well as production methods and suppliers that can use non-Chinese fluorite.
2	• The use of EUV exposure equipment involves high power consumption	• Possibility of simulating yield, throughput, and costs associated with switching production methods that are expected to reduce power consumption (such as nanoimprinting) and changing materials accordingly

Enables approaches to issues that cannot be solved by downstream customers alone or that are beyond their reach

Enables solutions to current issues to be implemented in virtual spaces without negative factors (such as shutting down existing operating equipment), and can be used to create new value and start up in the real world

Source: Both figures were compiled by Mizuho Bank Industry Research Department

(2) Ensuring psychological safety: Fostering a sense of security towards data contributions

- The barriers to sharing non-disclosed information are high, and it is assumed that by accumulating a track record of no concerns about leaks or misuse, that psychological safety will gradually increase and that the number of participating companies will expand

Factors that affect psychological safety

[Psychological safety]

Low ⟷ High

	Low	High
Data ownership	☐ Platform holder aggregates data ☐ Ownership transfers from data originator to platform holder	☐ Data ownership remains with the data originator ☐ Also assumes that the platform holder does not exist
Equality	☐ Platform holders reign in an overwhelmingly dominant position	☐ Even if platform holder exists, participants still interact on an equal footing
Judgements on participation	☐ Mandatory: No choice but to participate in certain economic activities	☐ Voluntary: Participants make decisions based on economic rationality
Road to the goal	☐ Aiming for large-scale change, which will take a considerable amount of time	☐ A certain amount of an effect is realized in a short period of time by accumulating small successes
Coercive data provision	☐ Coercive data siphoning: Penalties for non-compliance	☐ Almost none: Participants are free to decide according to the rules

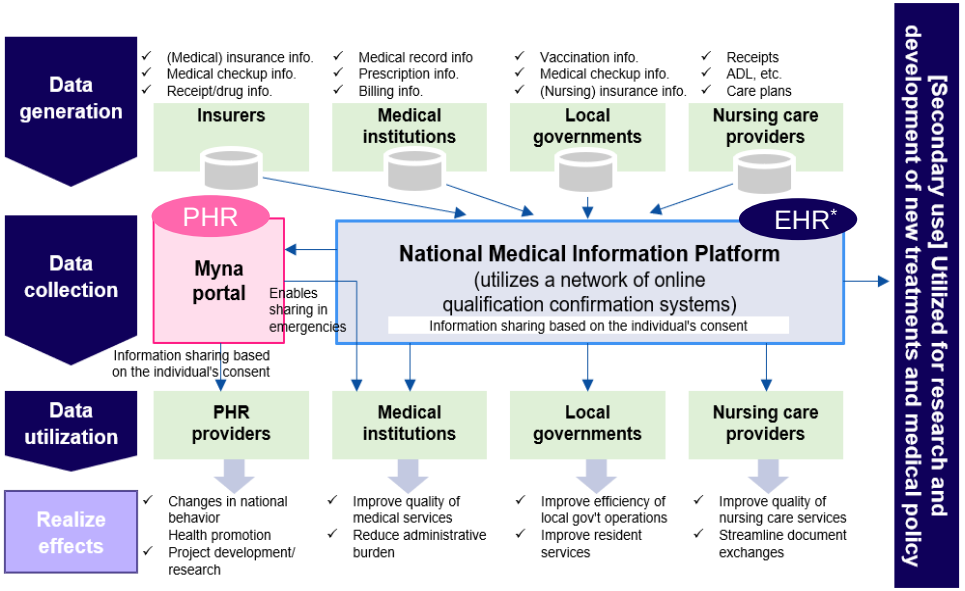
Coercive data siphoning has the potential to rapidly accelerate data linkages, but the sustainability of its effects are questionable because it does not foster psychological safety and may even encourage freeloaders

Source: Compiled by Mizuho Bank Industry Research Department

(3) Existence of a driving force: Government-led rule-making is essential for building health data infrastructure

- The government is required to make highly effective rules for the rapid establishment of health data platform and for opening up its use
- Under current medical DX reforms, with a goal of 2025-2030, the government is aiming to expand the information on the Mynaportal (which is a public PHR) and to develop/expand the National Medical Information Platform, which will be the backbone of the public health data platform; it is necessary for the government to carry out this process both quickly and reliably. In doing so, it should also provide support for societal implementation, such as devising mechanisms with excellent UX/UI, using subsidies to support introducing the system in medical and nursing care facilities, and encouraging individuals' recognition of and participation in the system.
- Based on this, in addition to innovative drug discovery and medical devices, it will be necessary to create rules for data utilization that promote innovation in health, medical care, and nursing care through the ingenuity of private PHR businesses

Overall picture of national medical information platform (future image)



Note: EHR is an abbreviation for "Electronic Health Record". EHRs are a mechanism for the mutual viewing of medical information (such as digital medical record information) between medical institutions

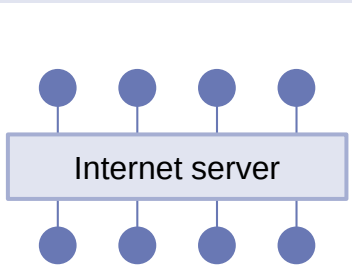
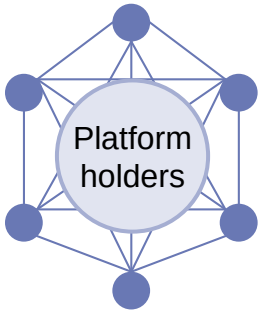
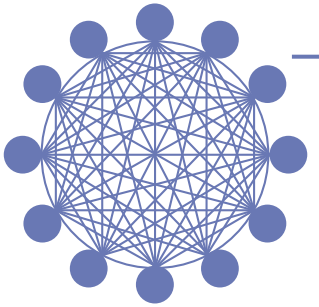
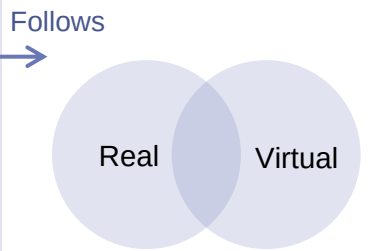
Source: Both figures were compiled by Mizuho Bank Industry Research Department based on Cabinet Office and Ministry of Health, Labour and Welfare materials

Medical DX process chart (related to national medical information platform)

◆ Operation began in October 2021, and target information is being gradually expanded

	FY2023	FY2024	FY2025~
Online qualifications verification system	In April, mandatory introduction at medical institutions and pharmacies	In December, integrated with Individual Number Card and health insurance card	
Digital prescriptions	In January, system began operation	Introduced to almost all medical institutions and pharmacies	
Digital medical record information sharing service (tentative)	Research/surveys on defining requirements necessary for standardization	Service construction	Start of operation in 2025 Gradual service expansion
Standard digital medical records		・Start of development ・Consideration of introduction support measures	~Introduced to all medical institutions by 2030
Expansion to local governments and nursing care providers	Documents standardized/put in cloud, and renovation of Mynaportal application site, etc.	Advance implementation of digitalization for application services to local governments for some services	Expand target local governments and services

<Addendum> A possible game changer due to the battle for leadership triggered by Web 3.0

Web1.0 (1990s)	Web2.0 (2000~2020)	Web3.0 (currently being developed)	Web4.0 (European Commission (July 2023), from 2030~)
Centralized		Decentralized	
One-way information transmission	Two-way information transmission and sharing	Sharing, owning, and exchanging decentralized information and value	Integration of real society and virtual spaces
			
[Main services] ・Homepages, email [Representative companies] ・Yahoo, eBay	[Main services] ・Social media, search engines [Representative companies] ・GAFA	[Main services] ・Crypto assets, NFT, blockchain [Representative companies] ・DAO (Decentralized Autonomous Organization)	[Main services] ・CPS (digital twins, metaverse) [Representative companies] -

<Web3.0 and after scenarios>

(1) Getting rid of GAFA	In Web2.0, platform holders possess an overwhelming amount of virtual data and have exclusive use of it to achieve high profitability and growth. By promoting decentralization that prevents the concentration of wealth in a few companies, data holders can protect and utilize their own data (=regain wealth)
(2) Evolution of GAFA	Envisioning a scenario in which GAFA shift to business models for the Web3.0 era and continue to exert their presence (such as in data storage and analysis), such as with Meta strengthening its metaverse business and Google and Amazon providing cloud services

Source: Compiled by Mizuho Bank Industry Research Department based on Ministry of Economy, Trade and Industry materials, European Commission materials, and publicly available information

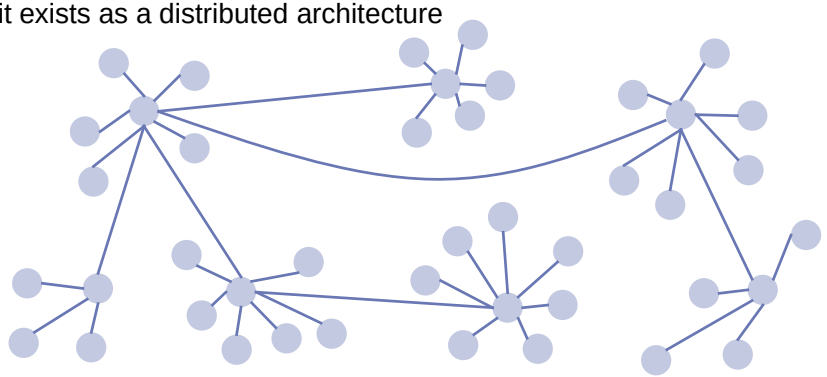
<Addendum> Decentralization, which is the premise of Web3.0, and its relationship with CPS

■ The presence or absence of a managing entity is a trade-off between participant equality and promoting collaboration (equal relationship = reliance on voluntariness)

"Decentralization" is classified into distributed and decentralized

<Distributed>

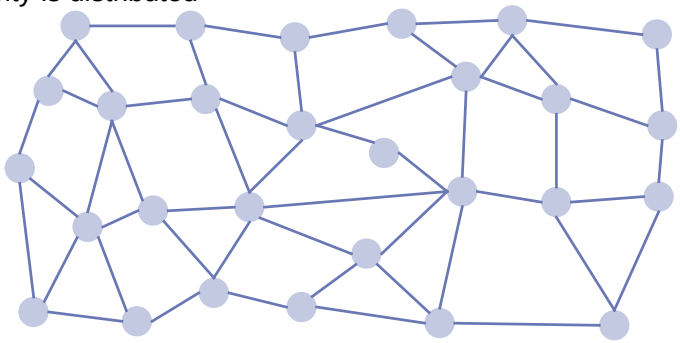
・While the operating entity exists as a core, it exists as a distributed architecture



<Decentralized>

・No operating entity, and authority is distributed

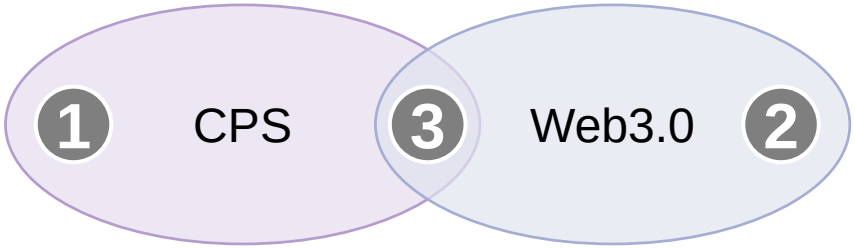
DAO
(**D**ecentralized **A**utonomous **O**rganization)



Source: Compiled by Mizuho Bank Industry Research Department based on Ministry of Economy, Trade and Industry materials

The relationship between CPS and Web3.0

CPS and Web3.0 have an overlapping relationship (≠connotative relationship)



1 An extension of Web2.0

- Each company can build its own platform or can connect using the infrastructure of an existing platform company

2 Web3.0 only in virtual spaces

- In metaverse spaces, for example, blockchain technology or NFTs are used when purchasing land or characters
- There are no platform companies; network participants connect to each other as equals and store data in a distributed manner

3 CPS × Web3.0

- Similar to (2), by using blockchain technology participants can connect to each other equally and store data in a distributed manner

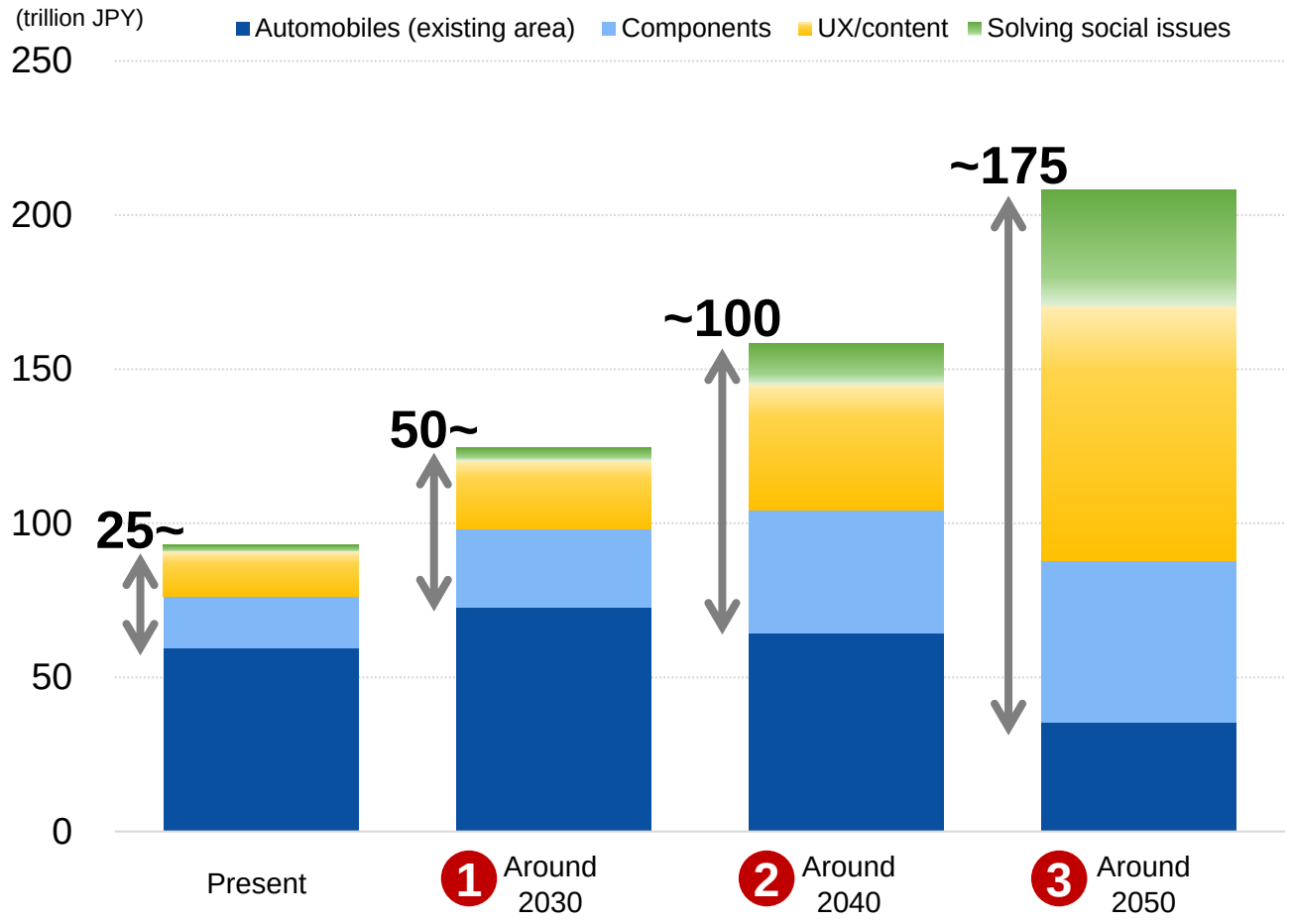
Source: Compiled by Mizuho Bank Industry Research Department based on Ministry of Economy, Trade and Industry materials and publicly available information

Conclusion:
A Future on the Path Towards Winning Strategies

Growth trajectory with the three winning strategy areas absorb the sales declines in automobiles (existing area)

- Around 2040, business that appeals to experiential value, rather than functional value, a traditional strength, will become the center of growth. Around 2050, further development will be achieved by solving social issues

Sales trends (global) expected on the path towards winning strategies



<Transition in Three Steps>

1 Maintain *monozukuri* industrial power

- ✓ The existing automobile area (new car sales, sales proceeds) will reach the peak of its growth
- ✓ Growth in UX/Contents will be centered on components and inbound (experiential consumption)

2 Automobiles (conventional) peak out

- ✓ New car sales and ownership will shrink as mobility becomes more diversified
- ✓ Continued growth in components and the UX/Contents business

3 "Solving social issues" starts in full swing

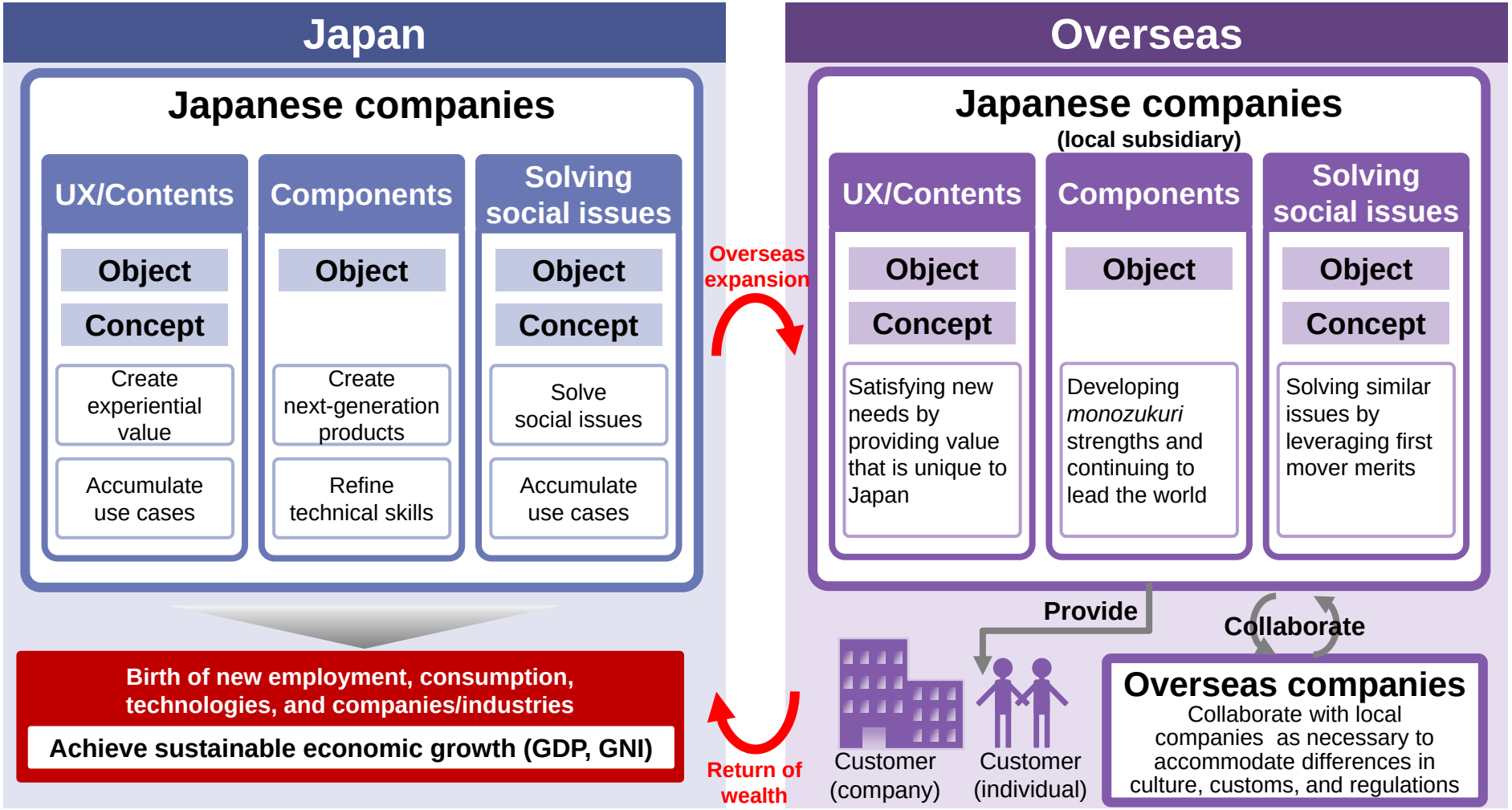
- ✓ Green business and robotics (including service area) to solve labor shortages will drive overall growth.

Note: For automobiles, chemicals, petroleum, nonferrous metals, material handling, machine tools, robots, electronics, shipbuilding, content, inbound, medical equipment, and pharmaceuticals

Source: Compiled by Mizuho Bank Industry Research Department

Achieving the transition: Establishing a virtuous cycle between Japan and overseas

- Sustainable growth is possible by taking new value that was realized domestically and then deploying it overseas and returning the wealth gained there to Japan



Note: This presentation assumes a nominal GDP growth of 2% due to productivity improvements from utilizing CPS, an increase in potential growth rate due to expanding capital stock, and rising prices

Source: Compiled by Mizuho Bank Industry Research Department

Utilizing Japan as a knowledge manufacturing base: Fertile soil for continuing to sow the seeds of the next generation

	Past Mother market	Future Social experiment ~ practical setting
Consumer market	Homogenous market of 120 million people (commensurate and stable size)	Treasure trove of data: • Abundant data on the elderly • All-in-one *monozukuri*-related data (products, components, machinery, materials)
Production	Manufactures highly functional and multifunctional products (established manufacturing know-how)	Value creation: • Technologies, products, and services solve social issues where Japan is ahead of other countries, or create experiences that are unique to Japan
R&D	Create new value and expand both domestically and overseas	Practical application: • Materialize solutions by moving forward with demonstration/implementation ahead of the rest of the world • Flexible support from prototyping to mass production

<Need for transition>

- **Consumer market**
  Market size is shrinking due to population decline. Furthermore, by 2050 the elderly ratio will increase from just under 30% to just under 40%
- **Manufacturing and R&D base**
  Due to structural changes in the automobile industry and the impacts of CPS, it will be difficult to compete along the same lines as before

<Preconditions for achieving the above>

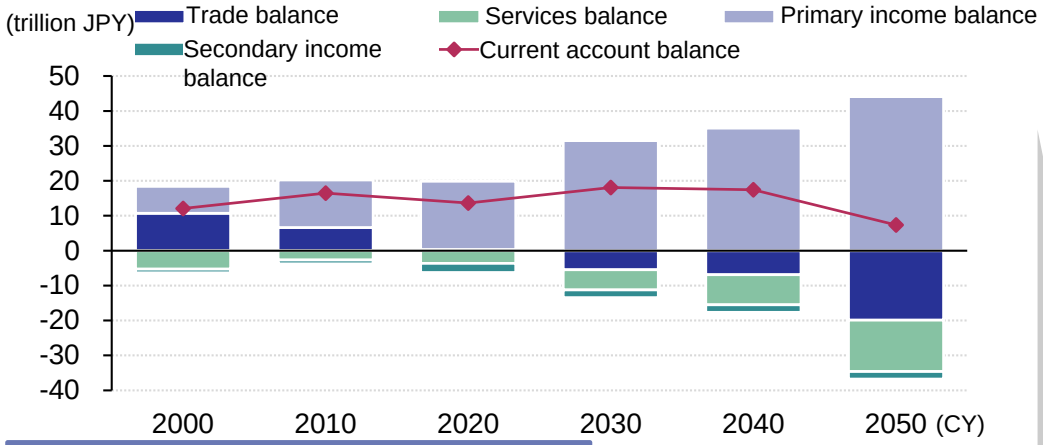
- **Ensuring data consistency**
  Although a scenario with overseas business expansion is expected in the future, industrial agglomeration centered around domestic demand will remain to a certain degree
- **Localizing global challenges**
  Adjust to local acceptability and preferences in terms of culture, customs, regulations, etc.

Source: Compiled by Mizuho Bank Industry Research Department

Illustration of future current account balance: Avoiding becoming a credit disposition nation due to the contribution of income balance

- Accelerated digitalization and the local production for local consumption manufacturing, particularly of automobiles, have pushed both the trade and services balances into a permanent deficit. On the other hand, earnings from overseas have increased, and primary income balance (such as dividends from subsidiaries) have further expanded
  - While it is difficult for Japan to earn through trade and services, it has become an investment-oriented nation that earns money from the income balance that is the return on its overseas investments
- The receipt of this overseas income will compensate for the decline in domestic consumption and exports caused by population decline, and each citizen will enjoy greater affluence

Long-term outlook for Japan's current account balance based on the worldview in this presentation

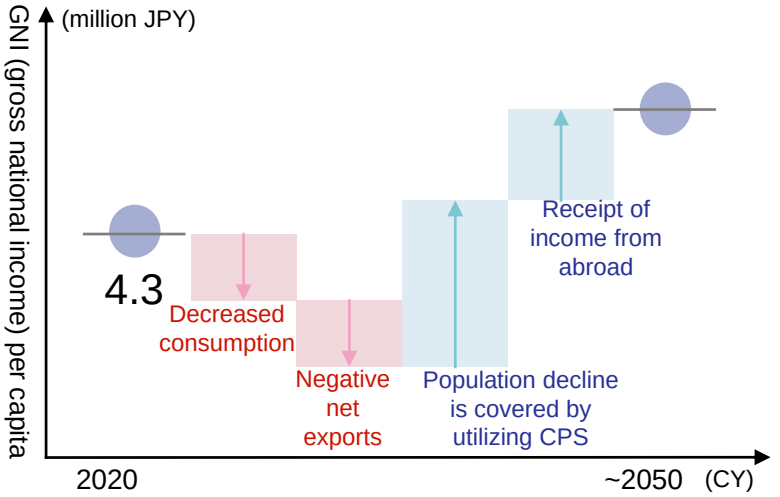


Long-term outlook for Japanese industry

- ✓ Due to changes in industrial structure, by 2050 automobile exports will drop to almost zero. In addition, local production for local consumption is progressing in the manufacturing industry as a whole as overseas business expands
- ✓ Towards the realization of CN, demand for fossil fuels will decrease but will remain to a certain extent, and the trade deficit will continue due to increased hydrogen imports
- ✓ In Japan, in addition to an increase in the number of visiting tourists, Japan can also expect to capture demand through cross-border e-commerce and the metaverse
- ✓ As a result of digitalization (such as CPS utilization), there is increasing use of overseas digital platforms (strengthening domestic digital industries is essential to reducing digital deficit)

Implications of future current account structure

- ✓ Although a deficit is expected in the trade and service balance, it has become clearer that Japan is an "investment-oriented nation" that earns money from the income balance, which is the return on investments such as overseas expansion and M&A
- ✓ Although it is expected that domestic consumption and exports will decline due to population decline, receipt of overseas income will compensate for these and GNI per capita will grow

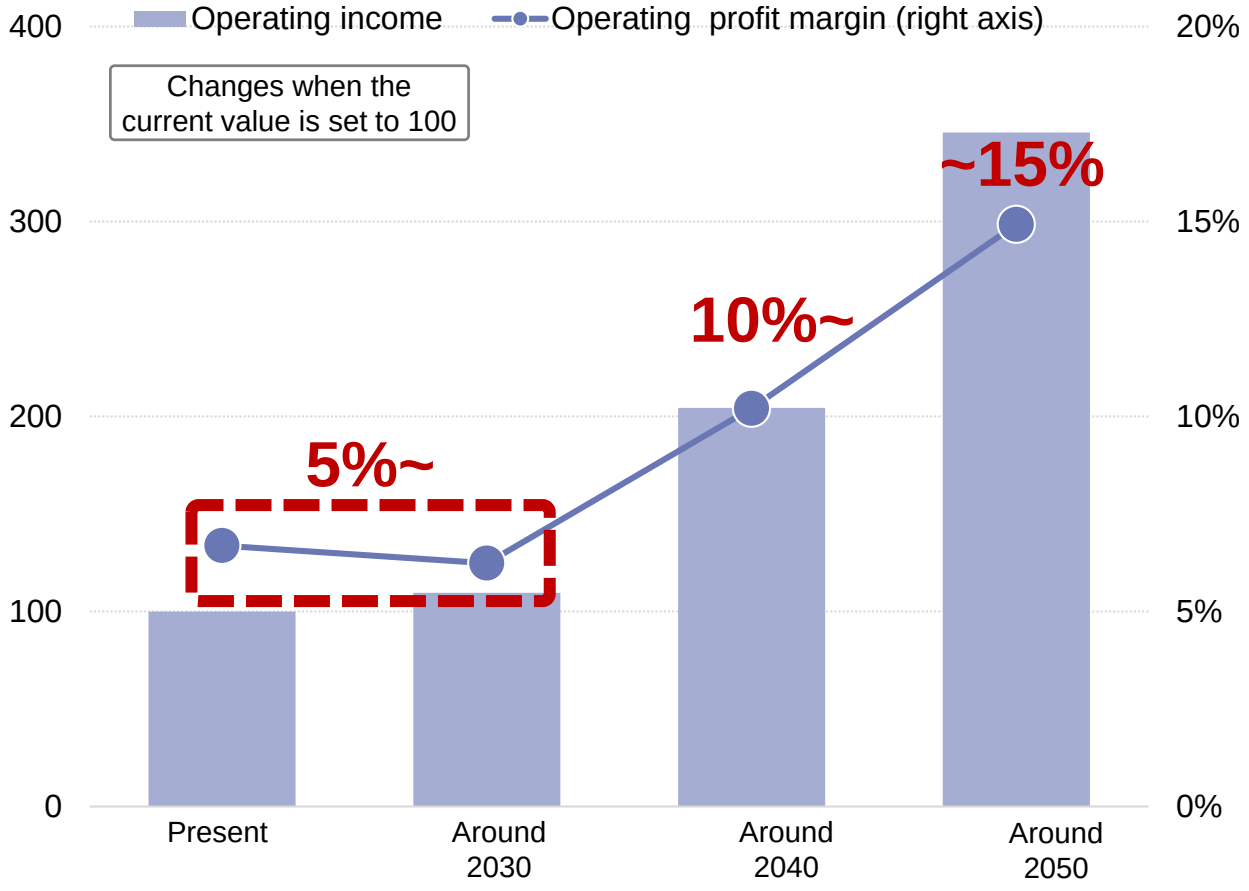


Note: Calculated based on the assumption that the exchange rate will return to 1 USD = JPY 120
Source: Compiled by Mizuho Bank Industry Research Department based on various materials

Monozukuri 2.0:The return of earning power, and achieving high margins

- Traditionally, the manufacturing industry has had an average profit margin of around 5%, but by utilizing CPS it can enjoy double-digit operating profit margins by 2050

Outlook for operating income and operating profit margin in the manufacturing industry



Note: For automobiles, shipbuilding, electronics, chemicals, steel, nonferrous metals, robots, machine tools, machinists, medical equipment, and pharmaceuticals

Source: Compiled by Mizuho Bank Industry Research Department

<Factors for improving profitability>

・Convert business model

- ✓ Strengthen profitability by changing earning method, such as through cross-industry fusion
- ✓ Enjoy premiums by providing new value to users

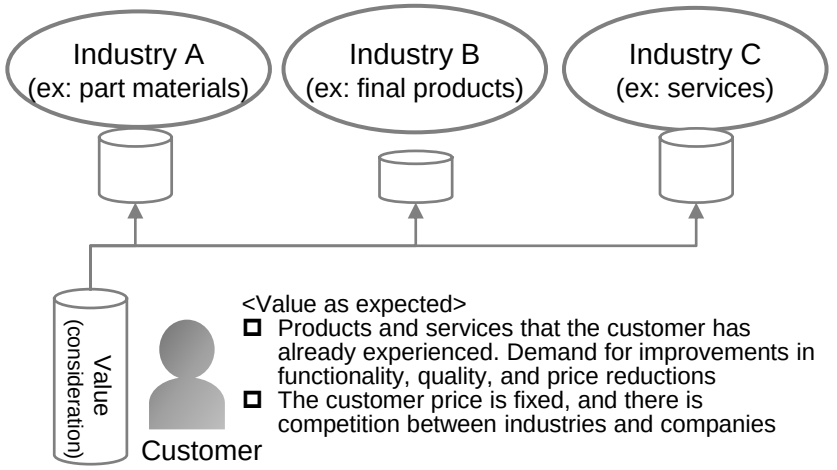
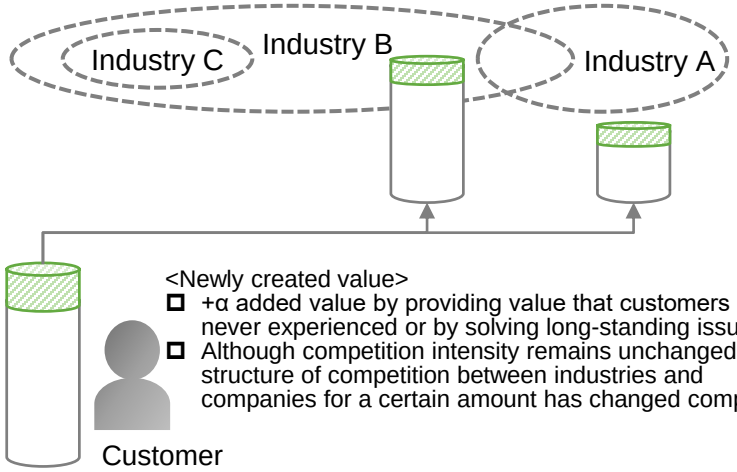
・Increase added value

- ✓ As before, aim for differentiation by improving functional value
- ✓ Add new value (UX) and increase unit prices

・Cost reduction effects

- ✓ Eliminate inefficiencies from R&D, design, manufacturing to sales
- ✓ Optimal allocation of personnel costs due to advances in automation (labor savings, unmanned operation)

Effects of converting business model: Switching from zero-sum games to positive-sum games

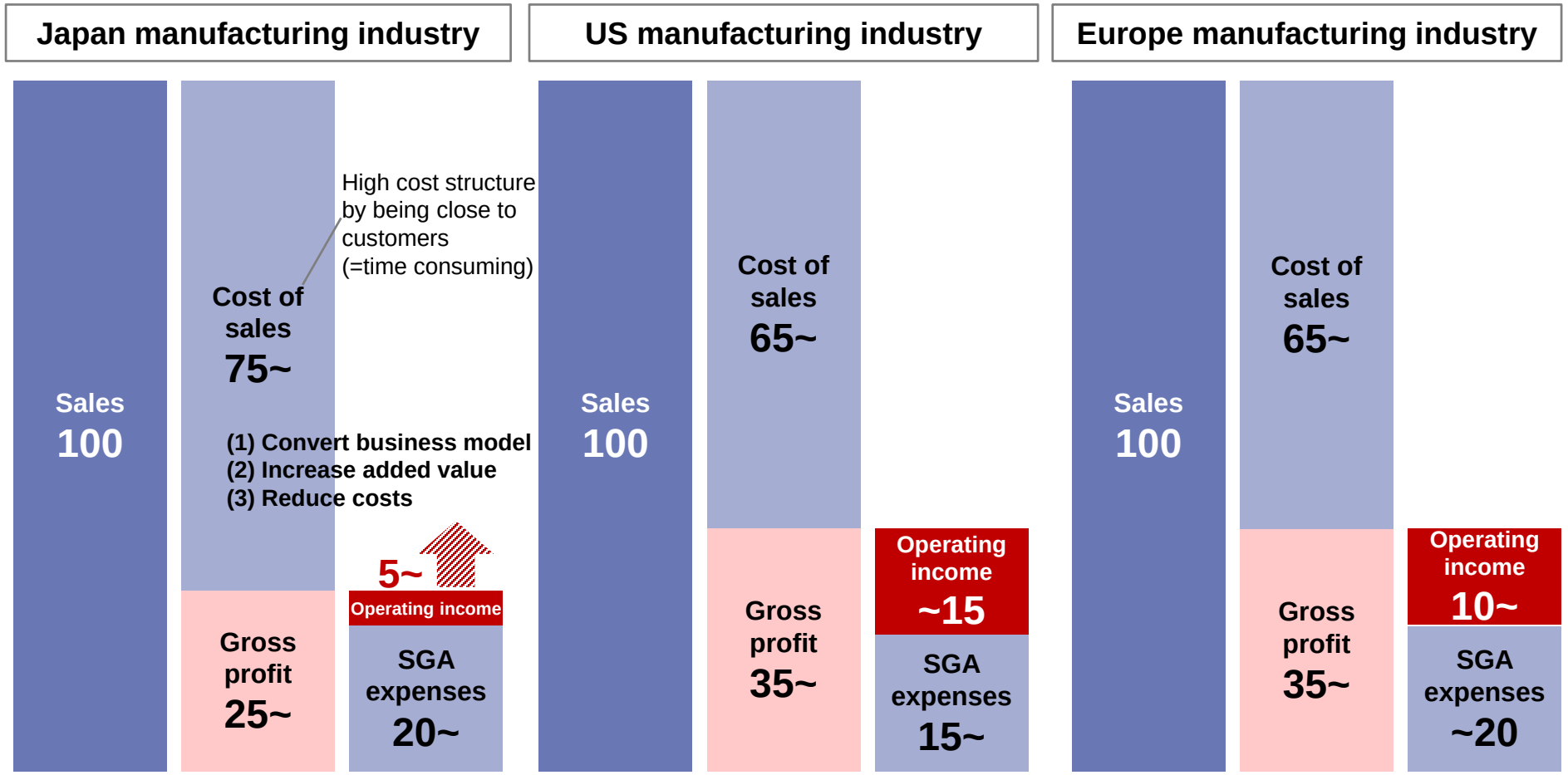
	Traditional business: Zero-sum games	Winning strategy: Positive-sum games
Inter-industry relationships	**[Barriers between industries]**  <Value as expected> ☐ Products and services that the customer has already experienced. Demand for improvements in functionality, quality, and price reductions ☐ The customer price is fixed, and there is competition between industries and companies	**[Industry fusion]**  <Newly created value> ☐ +α added value by providing value that customers have never experienced or by solving long-standing issues ☐ Although competition intensity remains unchanged, the structure of competition between industries and companies for a certain amount has changed completely
Automobile industry case	Materials → Parts → Products → Sales → Service ☐ Core areas for finished vehicle manufacturers are assembly, processing, and sales finance ☐ By grouping parts suppliers, the company can economically and stably procure parts that are competitive in terms of both quality and price	Materials → Parts → Products → Sales → Service ☐ The value provided by automobiles will expand from vehicles supply to experiential value (mobility, space, energy) ☐ The value of a finish product is broken down into parts (batteries, electronic parts, actuators)
	[Limited profitability from sharing certain resources] ☐ Profitability (operating profit margin) of Japanese manufacturers of finished vehicles varies from company to company, but is in the mid to high range of several percent ☐ The above profitability is the main target, and the operating profit margin of suppliers is around 5%. The operating profit margin of cab service providers, for example, is around 1% due to heavy labor cost burdens	**[Transcend industry boundaries to realize greater value than 1+1=2]** ☐ Customers will enjoy increased convenience (such as on-demand vehicle dispatch and various transportation services) and new services (such as personalized vehicle interiors) ☐ It is assumed that some areas with zero-sum games with existing businesses will remain, such as energy and transportation services

Note: Assumes the winning strategies of UX/Contents and solving social issues
Source: Compiled by Mizuho Bank Industry Research Department

State of the manufacturing industry: Achieving world-class profitability that cannot be achieved by “craftsmanship"

- Profit margins similar to those in the US and European manufacturing industries can be achieved by going past *suriawase*, which has been a stronghold of the Japanese manufacturing industry in the past

P/L comparison of manufacturing industry in Japan, the US, and Europe



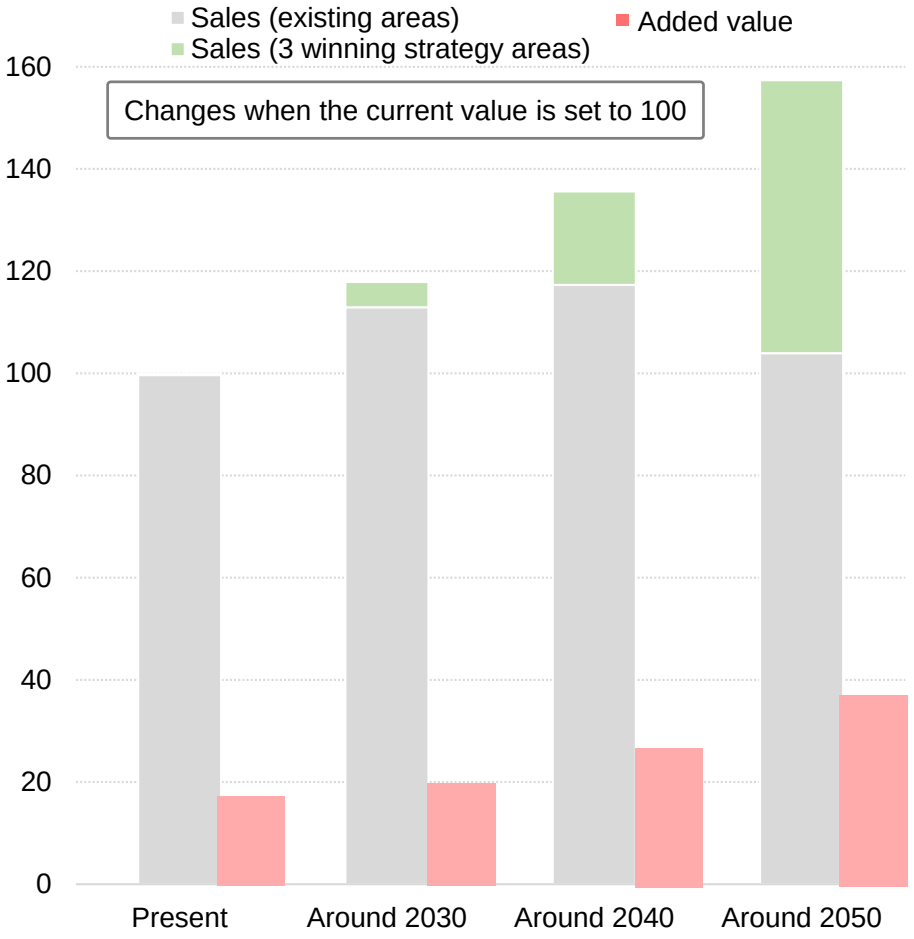
Note: For listed companies in each country/region for transportation machinery, machinery/electrical products, materials/processed materials, food, consumer goods, and pharmaceuticals/biotechnology (average values from 2000 to 2022)

Source: Compiled by Mizuho Bank Industry Research Department based on SPEEDA

The meaning of reaching global standards: Expect full-scale investments in human resources by expanding added value

- By increasing added value, it is now possible to actively invest in human resources, which was difficult with conventional profitability (operating profit margin of around 5%)

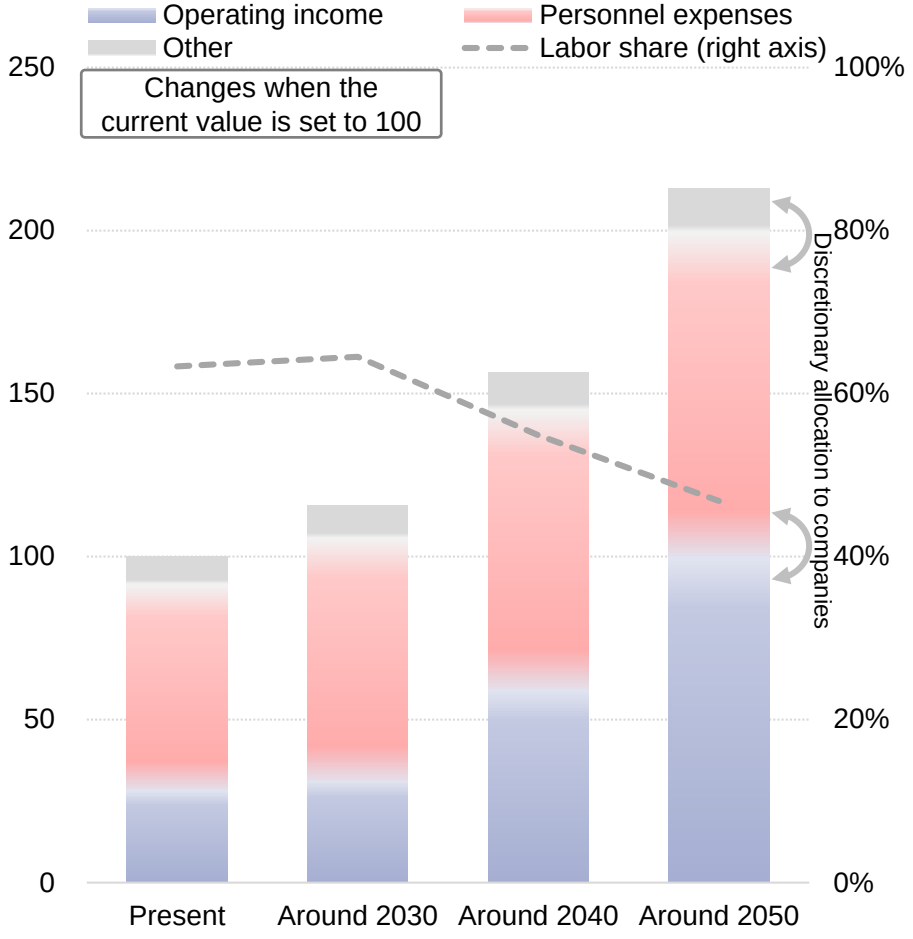
Trends in sales and added value in existing and new areas



Note: Added value is estimated as operating income + personnel expenses + interest expenses + movable/immovable property rental fees + taxes and dues

Source: Compiled by Mizuho Bank Industry Research Department

Changes in added value (by composition)



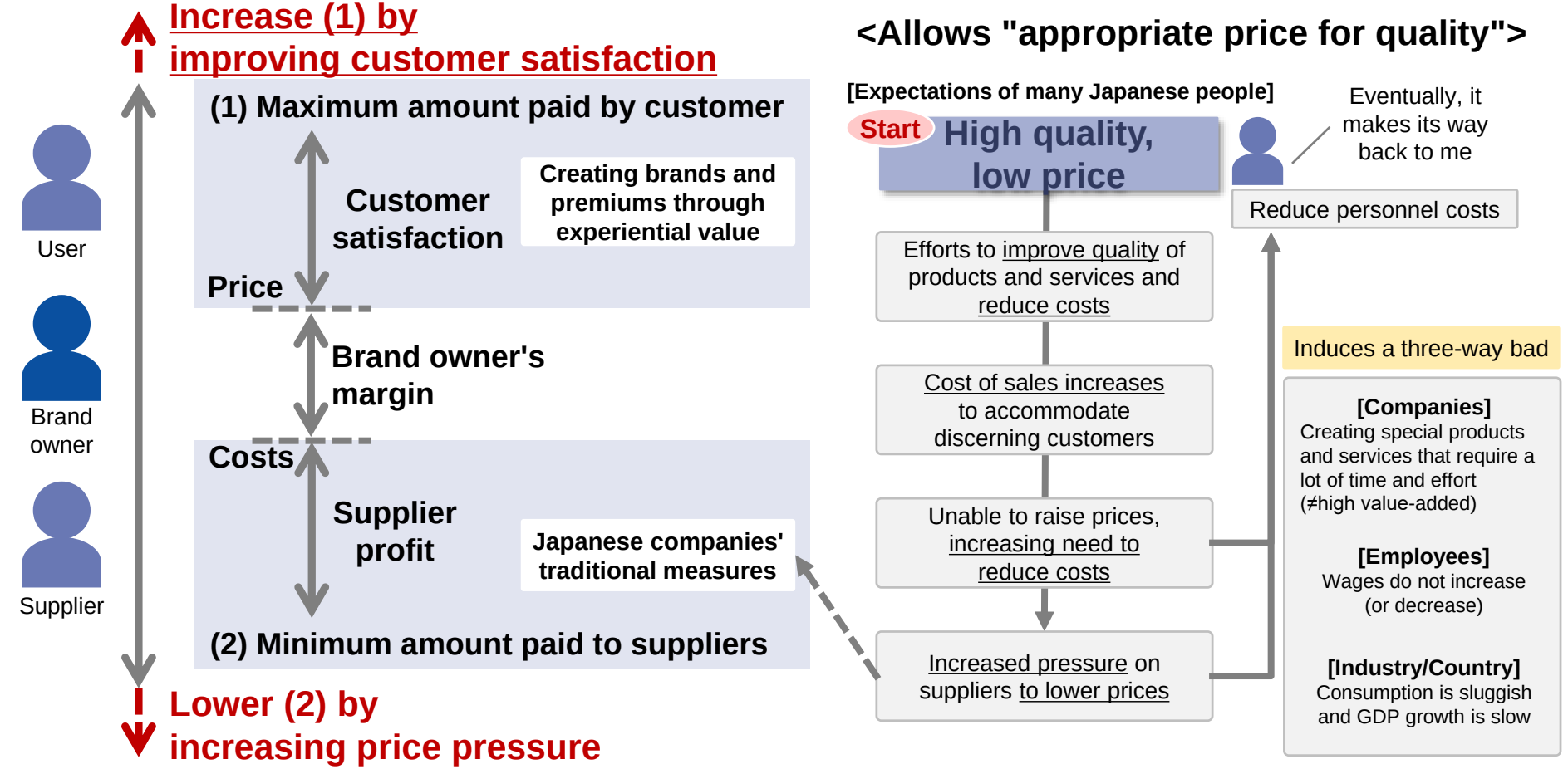
Note: Assumes that personnel expenses, interest payments, rental fees for movable/immovable property, and taxes and dues will remain at the current sales ratio

Source: Compiled by Mizuho Bank Industry Research Department

Need to change mindset from the supremacy of "high quality / low price"

- Traditionally, Japanese people have tended to prefer quality over price, but this has resulted in increasing pressure on companies to reduce costs, including personnel costs. The afore-mentioned improvements in profitability requires that the end user takes on the premium portion of the experiential value

Thoughts on value

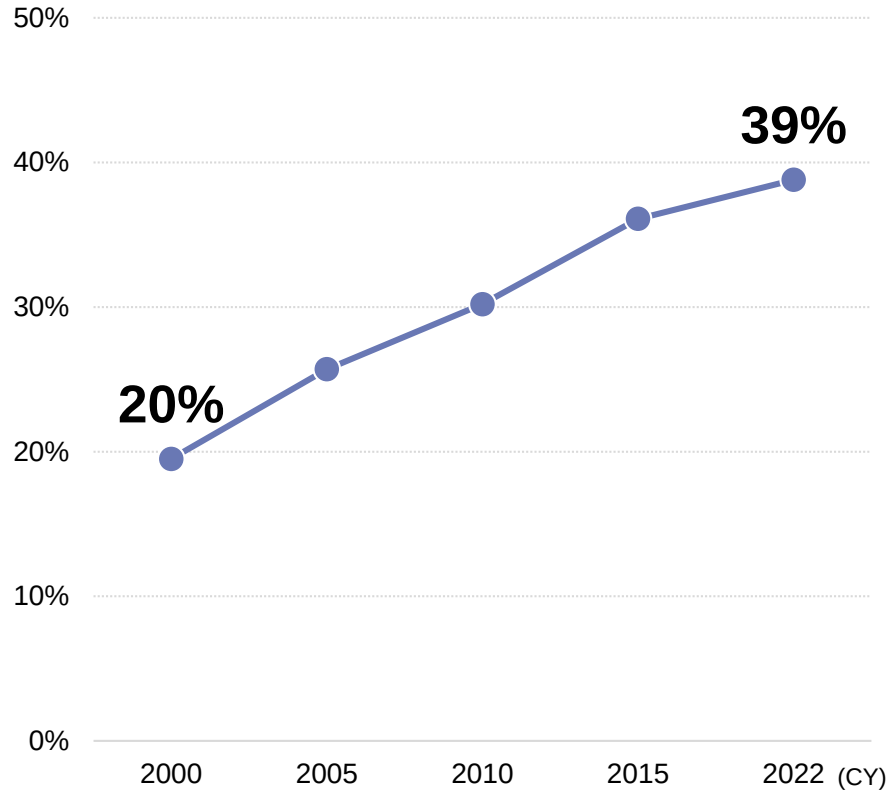


Source: Compiled by Mizuho Bank Industry Research Department

The elderly, who account for approx. 40% of domestic consumption expenditures, are the key to optimizing prices

- As Japan's population ages, consumption expenditures by elderly households as a percentage of total consumption expenditures continue to reach, and nearly reach 40%
- Consumption expenditures by the elderly tend to decline significantly after the age of 70, but this is largely due to their working conditions

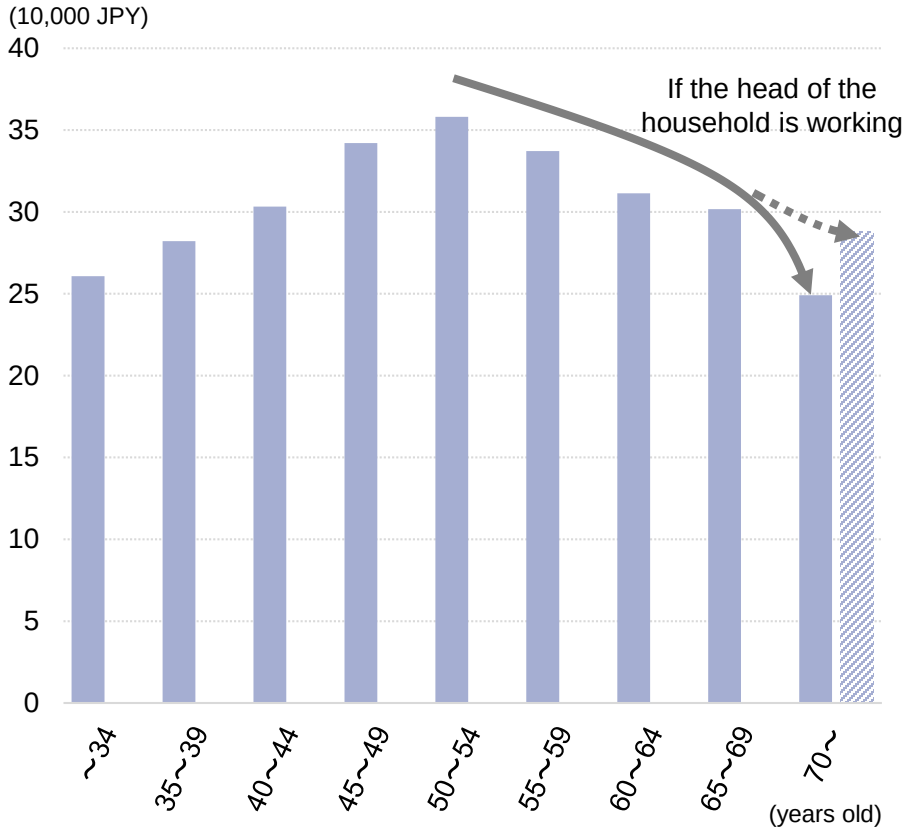
Consumption expenditures by elderly households as a percentage of the total



Note: Percentage of household consumption expenditures in households where the head of the household is 65 years of age or older

Source: Both figures were compiled by Mizuho Bank Industry Research Department based on the Family Income and Expenditure Survey by the Ministry of Internal Affairs and Communications

Household consumption expenditure for households with two or more people (by age group of household head, monthly average)

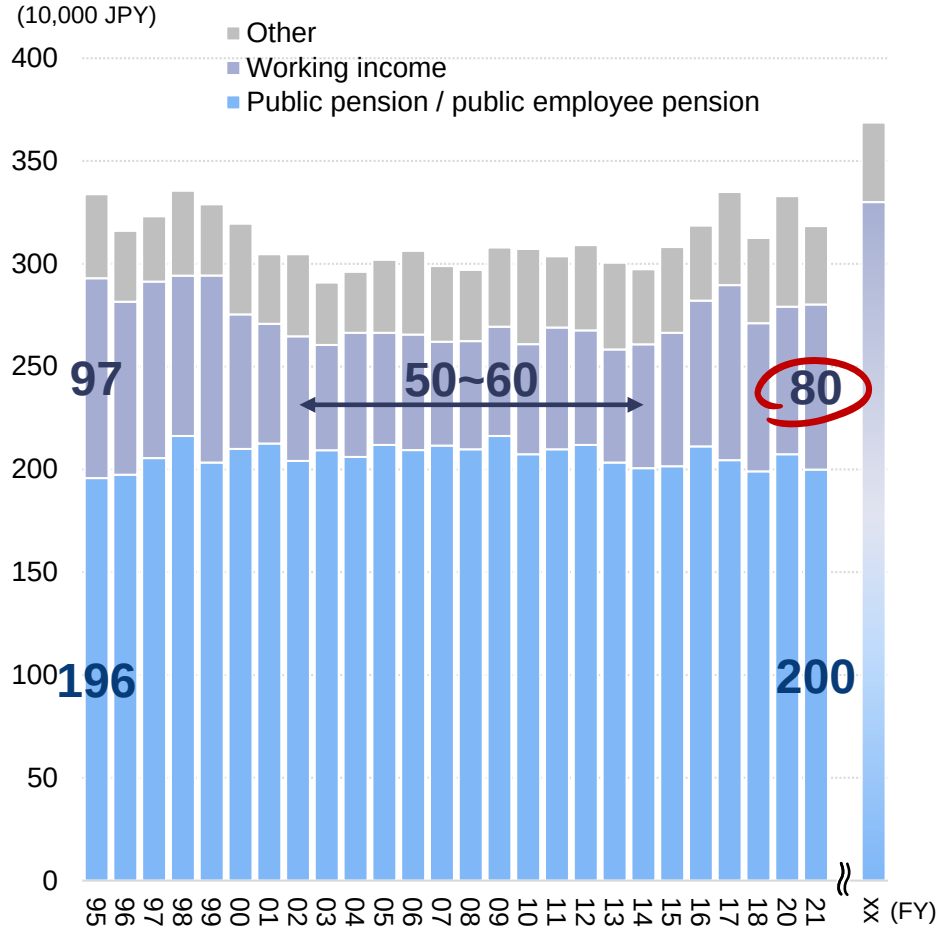


Note: Graph data is from 2023

Trends in income for elderly households: Flat over the past quarter century

■ Pensions account for most of the elderly's income, and income earned through work is lower than in the past. Even assuming the sustainability of pensions, it is essential for them to be more active in society in order to live a richer life

Elderly household income trends (FY1995 to 2021)



Source: Compiled by Mizuho Bank Industry Research Department based on the *Comprehensive Survey of Living Conditions* by the Ministry of Health, Labour and Welfare

The definition of "old-age life" is changing

Consumption expenditures (annual): Approx. JPY 2.85 million
(household with unemployed elderly couple)

Difference from pension (approx. JPY 2 million): JPY 850,000
→Equilibrium with current working income

- For individuals relying only on the public pension, there is a risk that they will go bankrupt in old age if they do not have approx. JPY 25 million (JPY 850,000 x 30 years) saved by the age of 65
- There are also cases where the above +α is necessary to realize hobbies and things they wish to do

Traditional old-age life

Connection until end of life

<Definition>
- ☐ Activities to enrich one's old age

<Examples>
- ☐ Engaging in hobbies and interests
- ☐ Saving in advance the funds needed for retirement

<Concerns>
- ☐ "Elderly refugees" (economically impoverished)
- ☐ Connection with society

Future old-age life

Healthy mind and body, extending lifespan

<Definition>
- ☐ Continuing to be active in society even in one's old age

<Examples>
- ☐ Engaging in hobbies and interests
- ☐ Earning the money needed to do so

<Resolving concerns>
- ☐ Maintaining economic and emotional wealth by maintaining connections with society

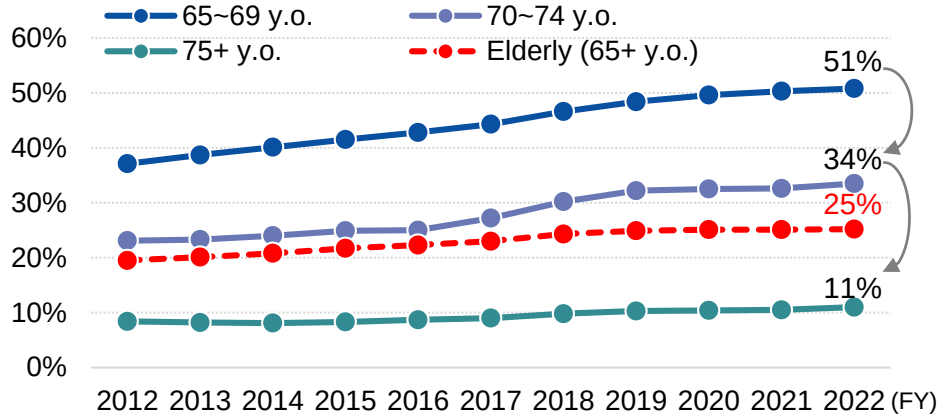
Source: Compiled by Mizuho Bank Industry Research Department based on Ministry of Economy, Trade and Industry materials and publicly available information

Employment status of the elderly: At a high level for developed countries. Retirement in two stages: 70 and 75 y.o.

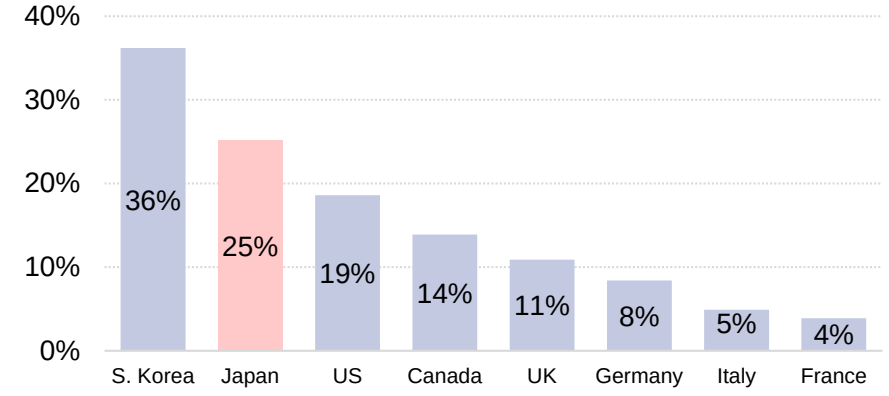
- In Japan, one in two people between the ages of 65 and 69 is employed, but this decreases to one in three between the ages of 70 and 74, and to one in 10 among those aged 75 and over, which gives an overall elderly employment rate of 25%. Furthermore, in South Korea, where the pension system is inadequate, nearly 40% of the elderly are employed

Trends in elderly employment rate

<Trends in elderly employment rate>



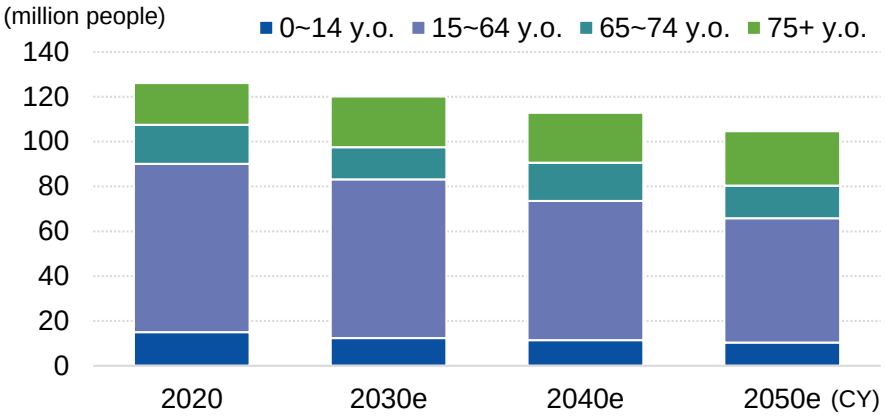
<Elderly employment rate in major countries (2022)>



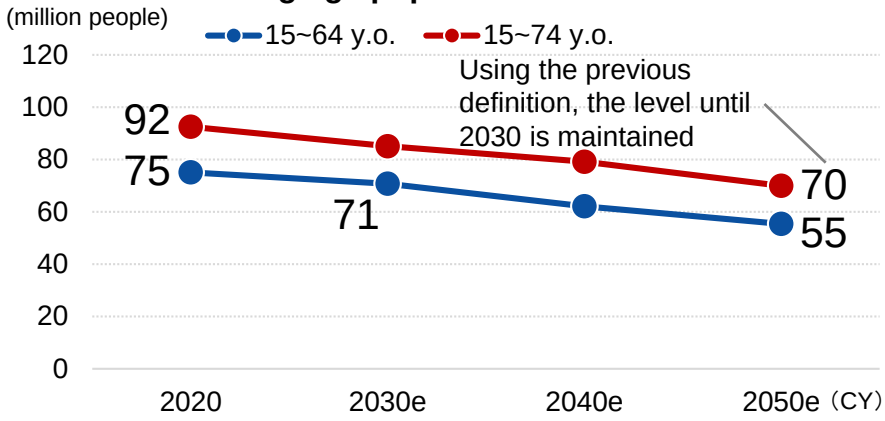
Source: Compiled by Mizuho Bank Industry Research Department based on Ministry of Internal Affairs and Communications materials

Outlook for population trends

<Population trends by age>



<Trends in working age population>

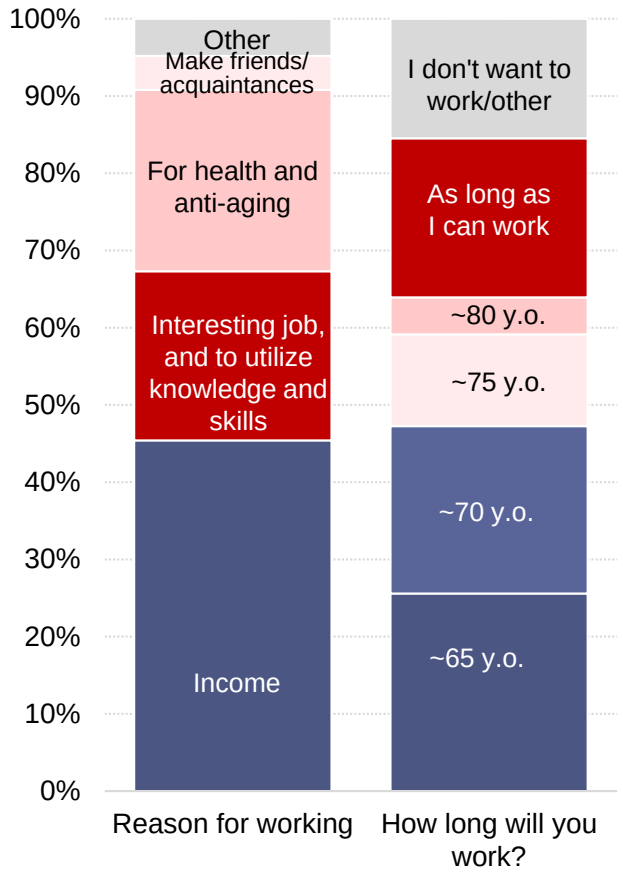


Source: Compiled by Mizuho Bank Industry Research Department based on National Institute of Population and Social Security Research materials

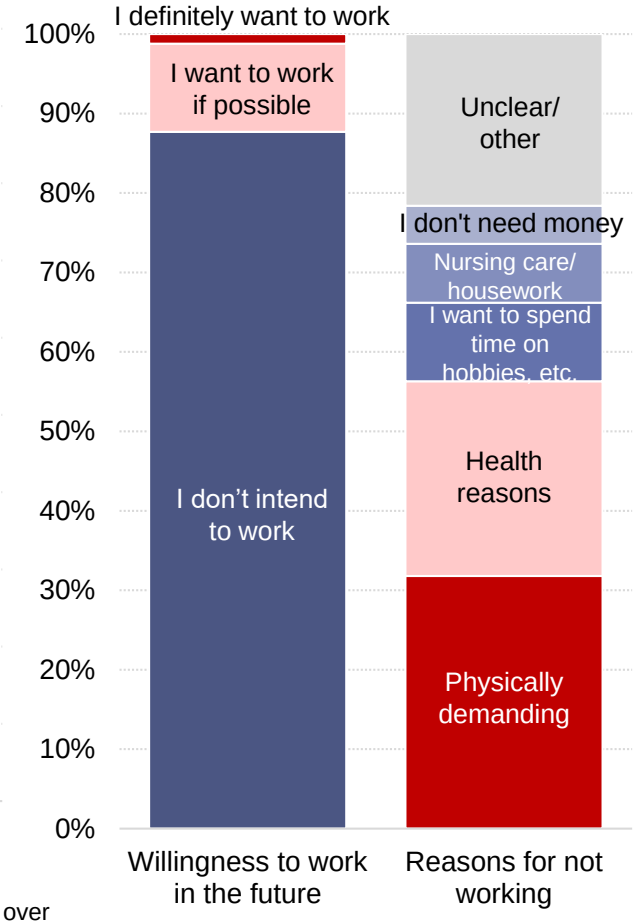
In the "era of 100-year lifespans," if you retire at the age of 70 then you will spend 30 years in old age

- Currently, there are many jobs that are physically demanding, and the majority of elderly people are not working due to physical reasons (incl. illness)
- In the future, with the use of CPS, it is envisioned that robots will be used for physical work, with elderly people remotely engaged in monitoring and operation

Elderly workers' motivation to work

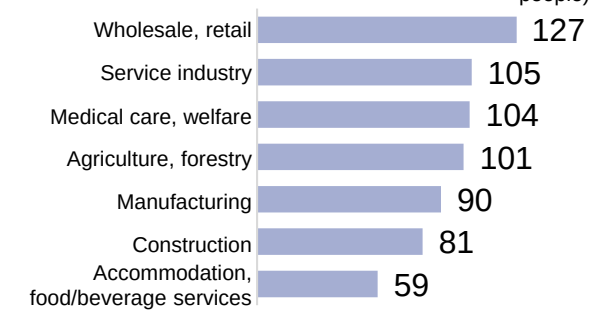


Elderly workers' reason for not working



CPS solve issues in the age of 100 million people working together

<No. of elderly workers (500,000+)> (10,000 people)



The elderly's strengths	Experience, knowledge, technology
The elderly's weaknesses	Physical function

- In general, elderly people are physically restricted due to aging and are not suited for manual labor
- Although it is expected that their many years of experience and knowledge will be utilized, the reality is that many elderly people are employed in jobs that require physical strength

Utilizing CPS will make it possible to perform physical tasks through remote control and monitoring of robots, potentially eliminating physical handicaps for the elderly

Note: Elderly workers refers to those aged 60 y.o. and over
Source: Compiled by Mizuho Bank Industry Research Department based on the Annual Report on the Ageing Society FY2020 by the Ministry of Health, Labour and Welfare

Image of employment for elderly people utilizing CPS: Putting years of merit into practice instead of withdrawing into a shell

- Even after the age of 70, elderly individuals' level of knowledge can be expected to exceed that of individuals in their 40s, and it is thought that elderly people can continue to play an active role in society by leveraging the knowledge they have cultivated through their life experiences, particularly in the industries in which they have been involved

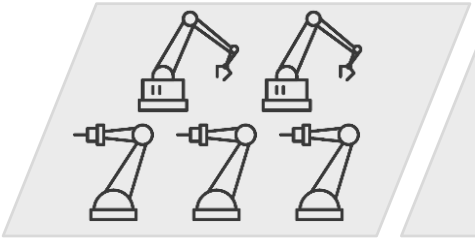
A way of working that is not limited by physical function

Elderly

<(Main) Supporting robots>
- Engaged in work such as remote monitoring and operation, which does not involve physical burdens
- Utilizes experience and knowledge accumulated from the past

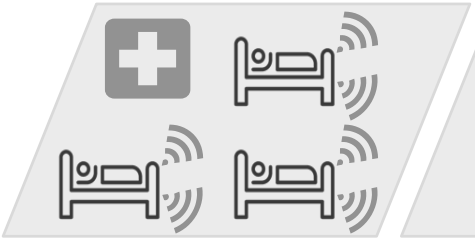
<(Secondary) Supported by robot>
- During physical work, an assist site greatly reduces the burden

[Factory (smart factory)]

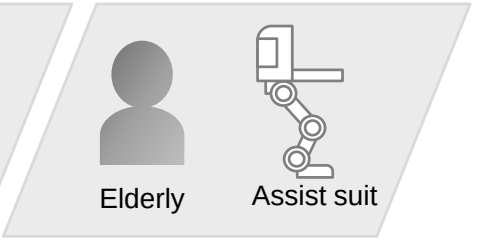


[Fields (smart agriculture)]

[Hospital/nursing facility]



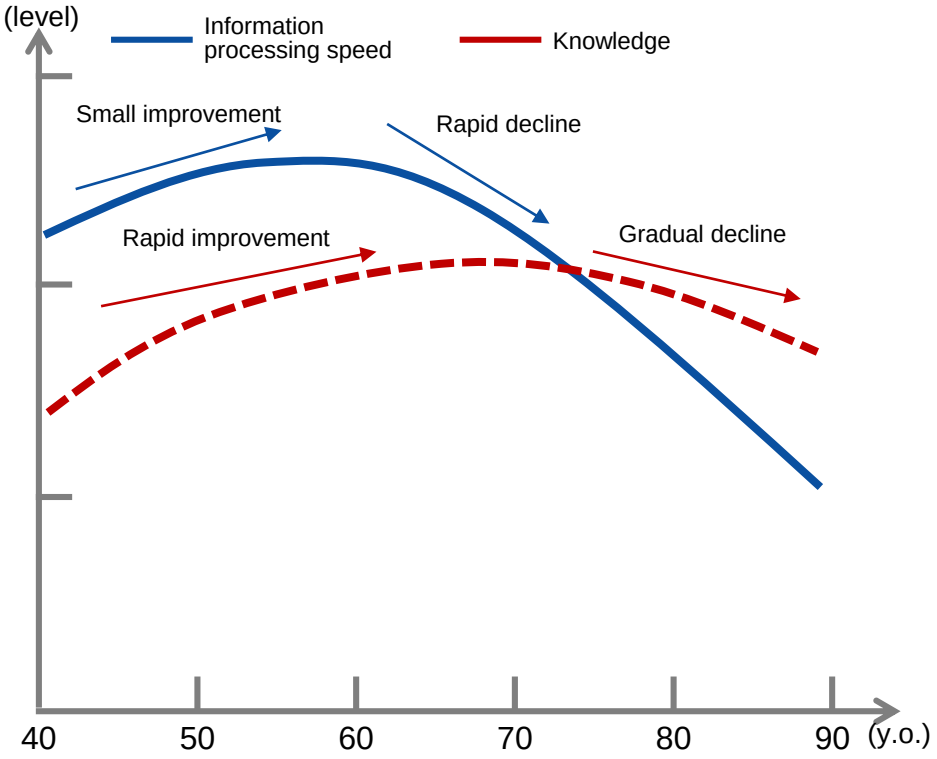
[Various work sites]



Source: Compiled by Mizuho Bank Industry Research Department

Changes in elderly individuals' intellectual abilities (image)

Information processing speed, which is an individual's ability to quickly process information given to them from the outside, shows a sharp decline after the age of 70, but knowledge accumulation remains at a certain level even after the age of 80

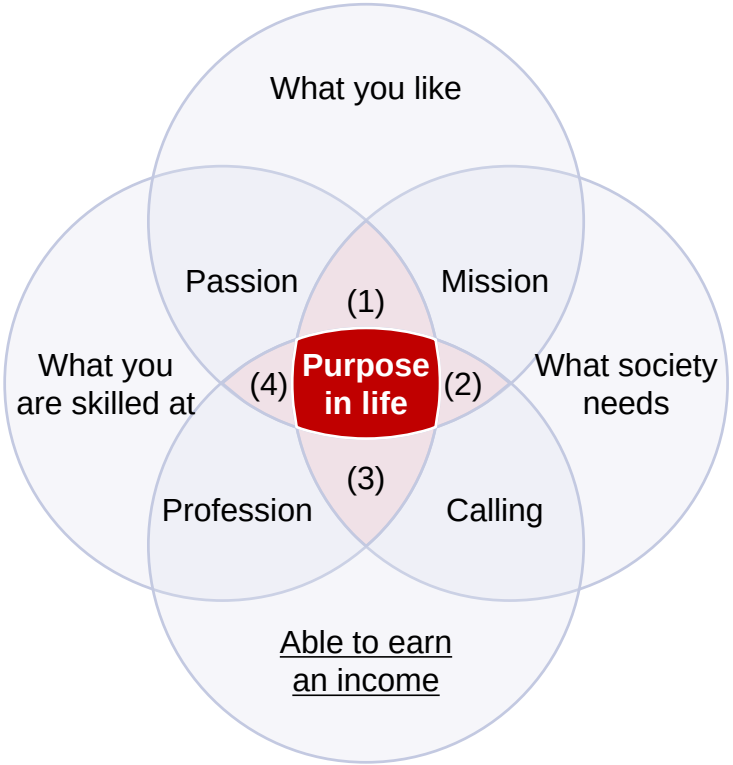


Source: Compiled by Mizuho Bank Industry Research Department based on "What intellectual abilities mature with age?" (https://www.ncgg.go.jp/ri/advice/04.html) by the National Center for Geriatrics and Gerontology Department of Epidemiology of Aging

Extending healthy life expectancy: Work is not drudgery, but the best way to find purpose in life

- Having a sense of purpose in life enables people to lead physically and mentally healthy lives. To this end, it is important to have contact with society and earn an income (assuming that the individual is working in a way that suits their individual situation)

The concept of "purpose in life" and its influence

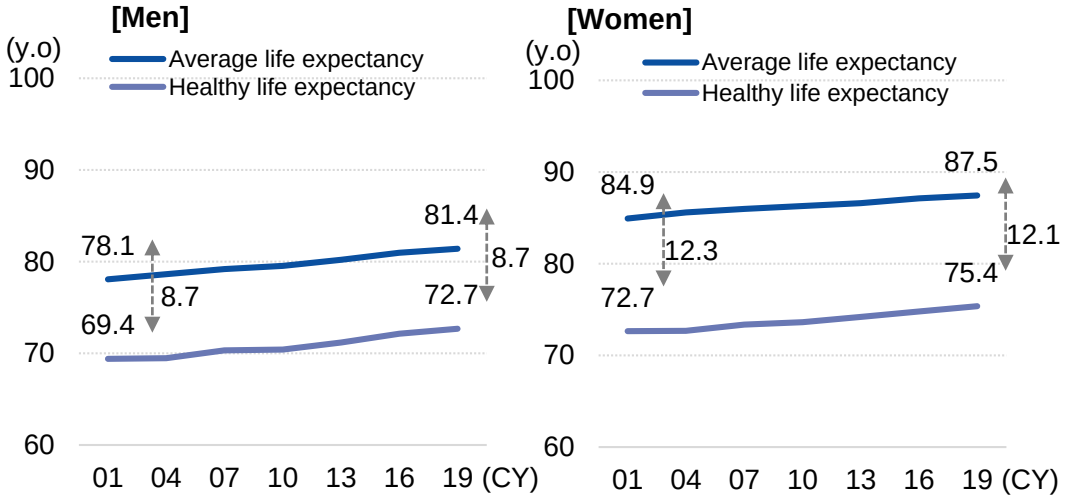


(1) Joy and fulfillment but no monetary compensation
(2) Exciting and satisfying, but a sense of anxiousness
(3) Comfortable, but a sense of emptiness
(4) Satisfaction, but a sense of futility

<The impacts of purpose in life>

Elderly individuals with a sense of purpose in life	Physical health	Function impairment (0.69x), dementia risk (0.64x)
	Health behavior	Insomnia risk (0.55x)
	Psychological distress	Risk of feeling hopeless (0.43x)
	Subjective wellbeing	Improvement in life satisfaction (1.14x)
	Social wellbeing	Emotional support (1.03x)

<Trends in average life expectancy and healthy life expectancy>

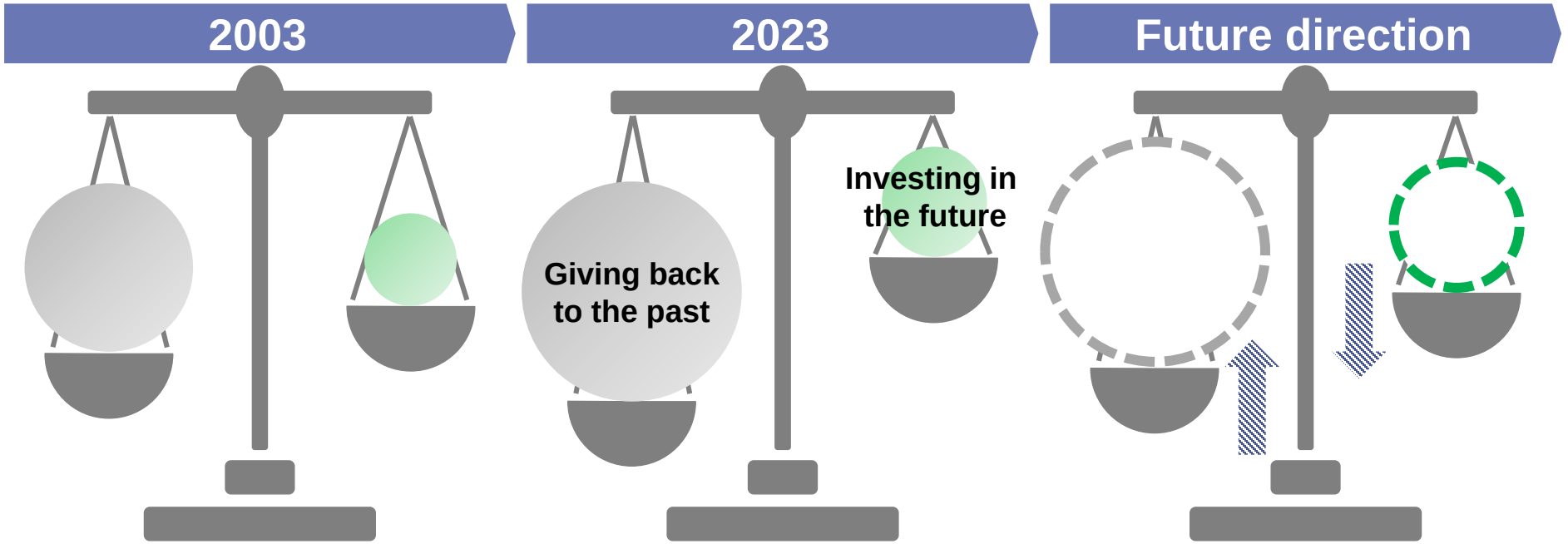


Note: The definitions for "purpose in life" for the left and right figures do not necessarily match
Source: Compiled by Mizuho Bank Industry Research Department based on *Ikigai and subsequent health and wellbeing among Japanese older adults: Longitudinal outcome-wide analysis* by Okuzono SS and Shiba K. in The Lancet Regional Health-Western Pacific, 2022, as well as on Ministry of Health, Labour and Welfare materials and publicly available information

Changes in budget allocation: A partial shift from the past to the future

- If social security costs for the elderly and national debt costs are categorized as "Giving back to the past", and if social security expenses for the non-elderly population and education/science promotion expenses are categorized as "Investing in the future," the former category is overwhelmingly the larger. Although new budgets have been allocated for measures to address Japan's declining birthrate, they continue to be insufficient

Changes in "past" and "future" investment allocation



8	Giving back to the past*	Social security (pension, medical expenses, welfare, etc.) and national debt expenses
2	Investing in the future	Social security (medical expenses, welfare, etc.), and education/science promotion expenses

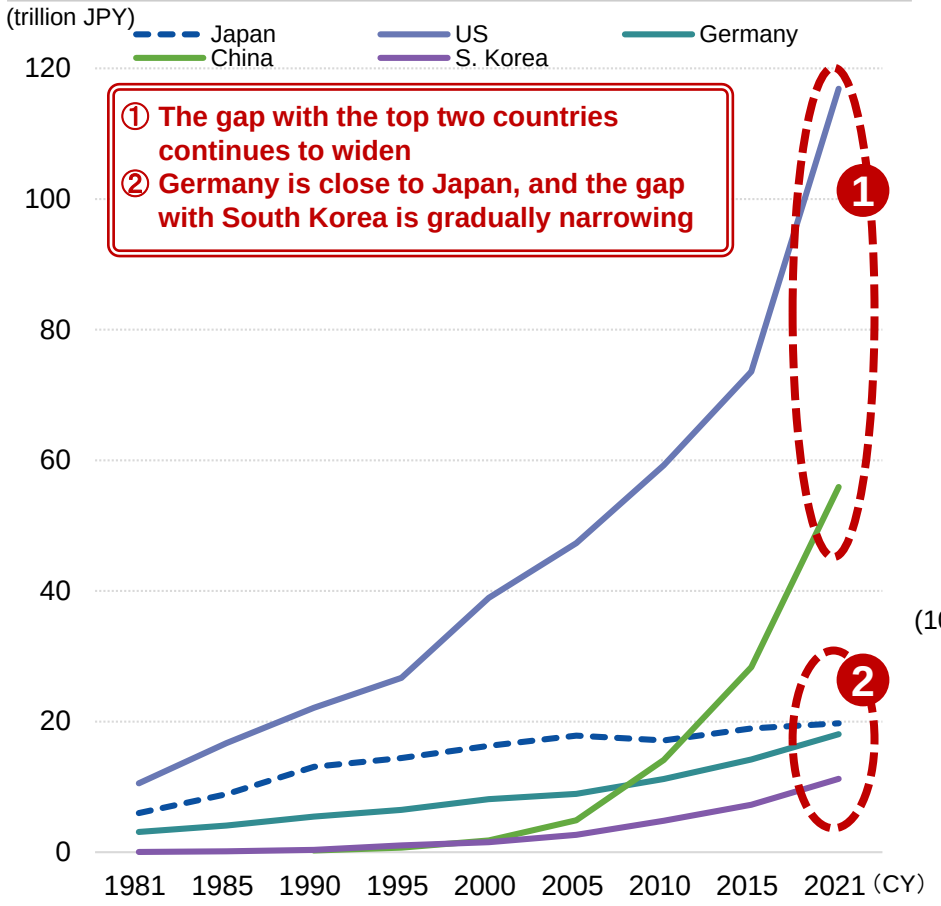
- **Focus is on giving back to those who have served in the past. Cyclical operation is used with government bonds to finance increased spending due to the aging of society**
- **While the aging of the population continues, elderly individuals being more active than in the past will curb spending, allowing more money to be allocated for investment in the future**

Note: Figures are approximate based on the expenditure budget
Source: Compiled by Mizuho Bank Industry Research Department based on Ministry of Finance and Ministry of Health, Labour and Welfare materials

A sense of crisis over the decline in Japan's scientific and technological capabilities: Concerns about the decline in Japan's status as a science and technology nation

- Although Japan's research and development expenditures are moderately increasing, other countries are taking an even more active stance than Japan. Currently, Japan's high reputation for science and technology is the result of seeds that were sown 20 to 30 years ago, and the decisions that are made now will determine what Japan looks like around 2050

Trends in national R&D expenses



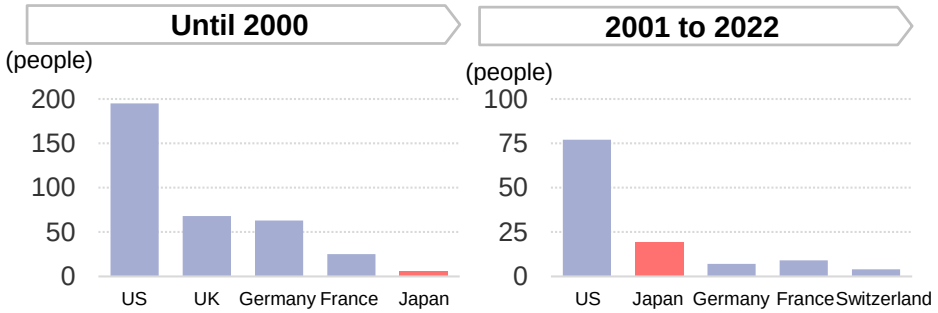
Note: Calculated with 1USD=145JPY, 1EUR=160JPY, 1CNY=20JPY, and 1KRW=0.11JPY

Source: Compiled by Mizuho Bank Industry Research Department based on OECD Stat.

Currently, Japan's science and technology are highly regarded

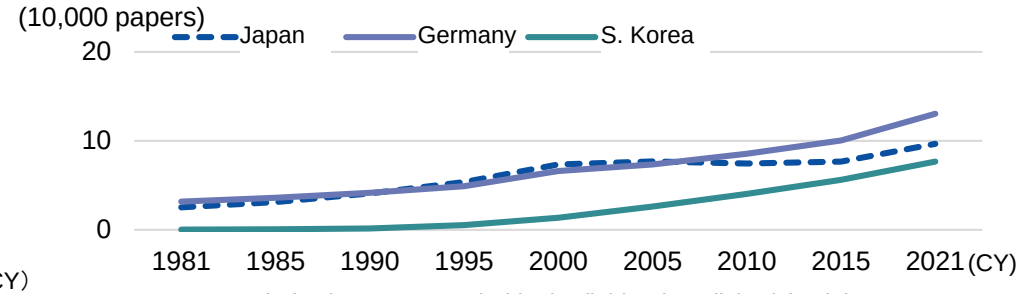
<Trends in number of Nobel Prize winners>

- A Nobel Prize takes approx. 30 years from discovery to award
- The increase in the number of Japanese Nobel Prize winners since the 2000s is the result of past upfront investments



<Trends in number of research papers>

- The number of Japanese research papers that become technology seeds is sluggish (US: 400,000; China: 600,000)



Note: Counts Nobel Prizes are awarded in the fields of medicine/physiology, chemistry, and physics

Source: Compiled by Mizuho Bank Industry Research Department based Japanese Science and Technology Indicators 2023 by the National Institute of Science and Technology Policy and on publicly available information

Investments in science and technology are sowing the seeds for the next generation: Ripple effects are expected to be approx. 10 times as large

- By increasing investments in science and technology fields through the reduction effects from CPS and system changes, the hope is that it will create products and technologies that will drive Japan and Japanese industry after 2050

Effects of investments in science, technology, and innovation

25 trillion JPY

CPS reduction effect

- Social security: medical and nursing care
- Infrastructure (maintenance / management costs)

Consider reducing through system changes

- Social security: Medical and nursing care, pensions

Disincentives to work

<Social security income limits (ex.)>

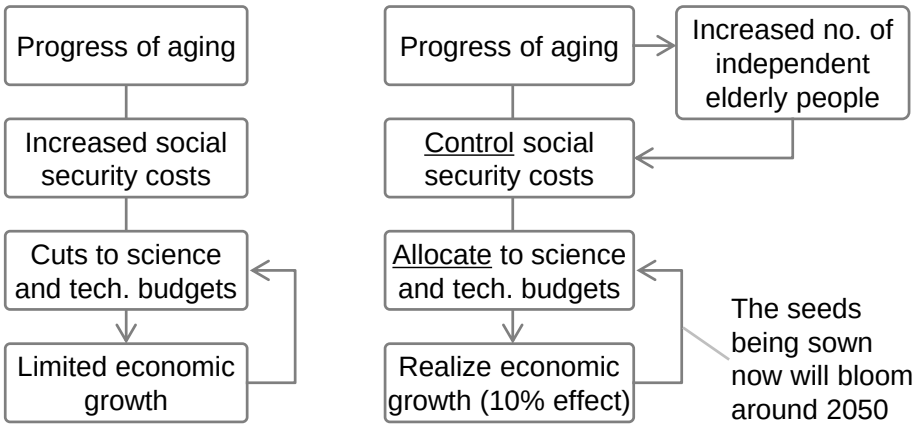
- Medical care: Burden ratio (10-30%) determined according to taxable income
- Nursing care: same as above
- Pension: Depending on total monthly remuneration, may be suspended

In addition to increasing the burden on working people, the same rules also apply to people who do not work (≠ people who cannot work)

Expected economic effects of investments in science, technology, and innovation

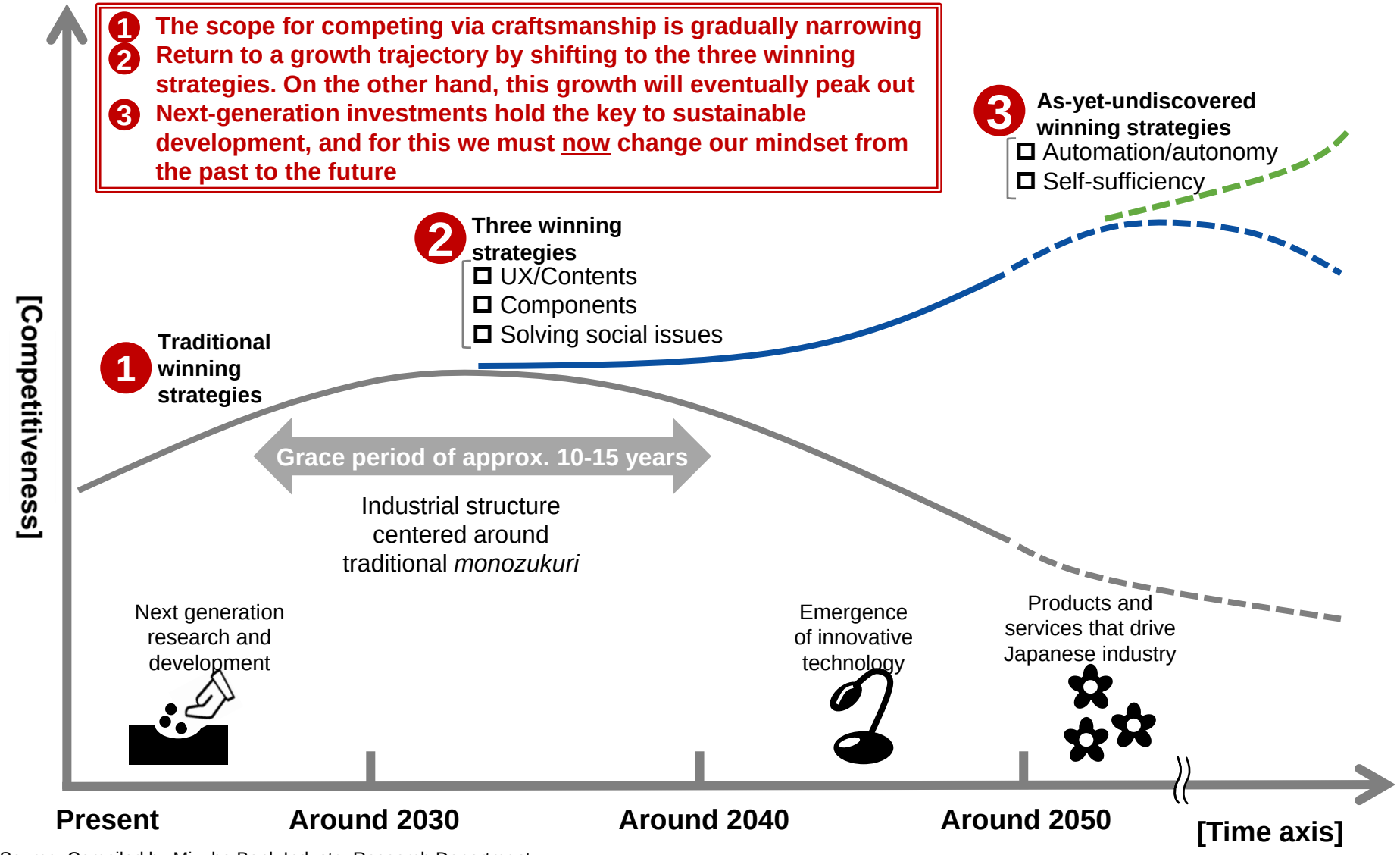
- The economic effects (impact on GDP, employment, and private investment, etc.) of investments in science, technology, and innovation (such as research and development) can be expected to have a lasting effect of increasing the economic growth rate
- It is reported that if research and development investment increases by 1% of GDP, then a cumulative increase of approx. 10% can be expected
  - For example, if investment increases by 1 trillion JPY, then the cumulative growth effect will be approx. 10 trillion JPY

<Current: Negative spiral> → **<Future: Positive virtuous cycle>**



Note: CPS reduction effect is estimated as of 2050
Source: Compiled by Mizuho Bank Industry Research Department based on Cabinet Office materials

Future sustainable development in 2050 and beyond



Source: Compiled by Mizuho Bank Industry Research Department

Towards as-yet-undiscovered winning strategies: Sowing seeds in the areas of automation, autonomy, and self-sufficiency

- Although the details will not be explored in this presentation, the following are assumed to be as-yet-undiscovered winning strategies that will continue in the future even further than the path towards the three winning strategies.

[Automation]	[Autonomy]	[Self-sufficiency]
Do work in accordance with established programs	Learns by itself to define and carry out tasks	Procure and circulate resources within Japan

<Developing to the next stage based on current winning strategy>

Expand

[Smart robots: From "automation" to "autonomy"]

- Achieve autonomy by accumulating automation technologies and knowledge and then improving from a service perspective
- Robots: Assumed that a human will operate, monitor, and control it. Examples include service robots (medical/nursing care, agriculture, transportation, logistics) and assist suits that help reduce physical burden
- Smart robots: Control systems and intelligence systems that flexibly operate on their own without human intervention

Expand

[Components: From "highly functional" to "human-like"]

- The parts that make up robots (such as high-sensitivity/low-power consumption sensors and high-efficiency/high-output actuators) and the materials with outstanding properties (such as thermal, electrical, or mechanical characteristics) that are used in them
- Advances in the development of flexible soft robotics and artificial muscles will enable movements similar to those of humans

<Creating game changers>

New

[Energy]

- Products and technologies that reduce dependence on foreign sources such as fossil fuels and that support decarbonization
- Perovskite solar cells, and nuclear fusion power generation, etc.

New

[Food]

- Products and technologies that contribute to improving food self-sufficiency in preparation for food price increases/shortages
- Alternative proteins and gene-edited foods, etc.

New

[Resource circulation: Moving away from a disposable society]

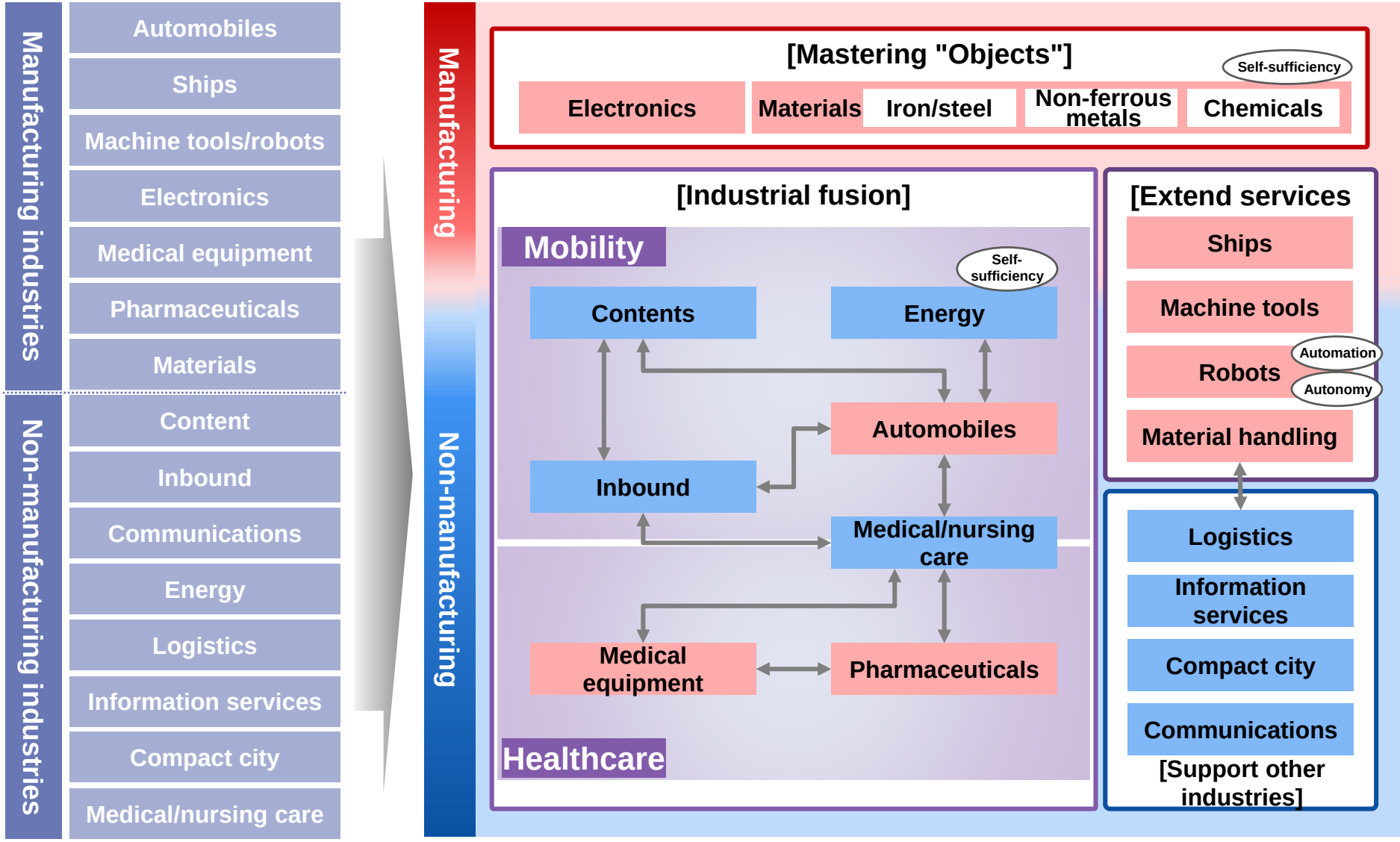
- Creating systems to ensure reliability, transparency, and economic efficiency
- Identification devices and traceability systems for waste products and waste parts, and highly efficient separation and recovery technologies (materials, parts, CO_2, etc.)
- Technologies to efficiently utilize domestic resources
- Recycling: Generate ethanol from combustible garbage
- Artificial photosynthesis: Separating hydrogen from water using sunlight and photocatalysts

Benefits of harvests: Improving the sustainability of Japan and Japanese industry, and contributing to solving global issues

Eliminate labor shortages ⇔ Reduce environmental impact ⇔ Strengthen economic security ⇔ Control outflows of national wealth

Source: Compiled by Mizuho Bank Industry Research Department

Conclusion: As industrial fusion progresses, "flagships" will become "fleets"



Source: Compiled by Mizuho Bank Industry Research Department

Industry fusion As-yet-undiscovered winning strategies

Appendix

Worldview in 2050

① Daily life time	Less work and housework, more free time, more digital contact. People enjoy digital play, but also value physical experiences
② Spaces	Increased emphasis on digital and virtual (metaverse), and a scarcity of real experiences. Languages and national borders will be transcended by the spread of cyberspace
③ Consumption	Consumption of goods and services will be divided into "work/service" and "play"
④ Movement	Advances in digitalization have reduced the need for movement. With the establishment of autonomous driving technology, people, goods, and services move. People are freed from need to have their work and residence be close to each other
⑤ Work	The spread of AI diagnostics and the development of regenerative medicine will increase healthy life expectancy and realize a "lifetime of active life. While people will abundantly enjoy digital play without health concerns, physical experiences (=experiential value) will also be emphasized
⑥ People	Demand for "high-level human resources" with technology-related expertise will increase, and companies will seek to secure human resources by securing specialized personnel from other countries and rehiring personnel for "retraining/relearning". AI will replace production, distribution, and clerical work, and humans will focus on the creative part.
⑦ Objects	Physical objects will be based around circulation, including a shift from ownership to use and recycling. Production and distribution of objects will be automated. Production systems will shift from mass production to high-mix, low-volume production
⑧ Money	Investments will be concentrated in intangible assets (knowledge and information, etc.). There will have been progress in substituting labor for capital, and labor participation rate will be declining
⑨ Information	Data collected from all aspects of consumers' daily lives will be thoroughly utilized in all phases of production activities via the use of AI and robots
⑩ Energy	Significant decarbonization will have been realized. There are declining needs for energy-intensive products such as ICE vehicles, gasoline, and steel, etc.

Source: Compiled by Mizuho Bank Industry Research Department

Manufacturing industry/product classification

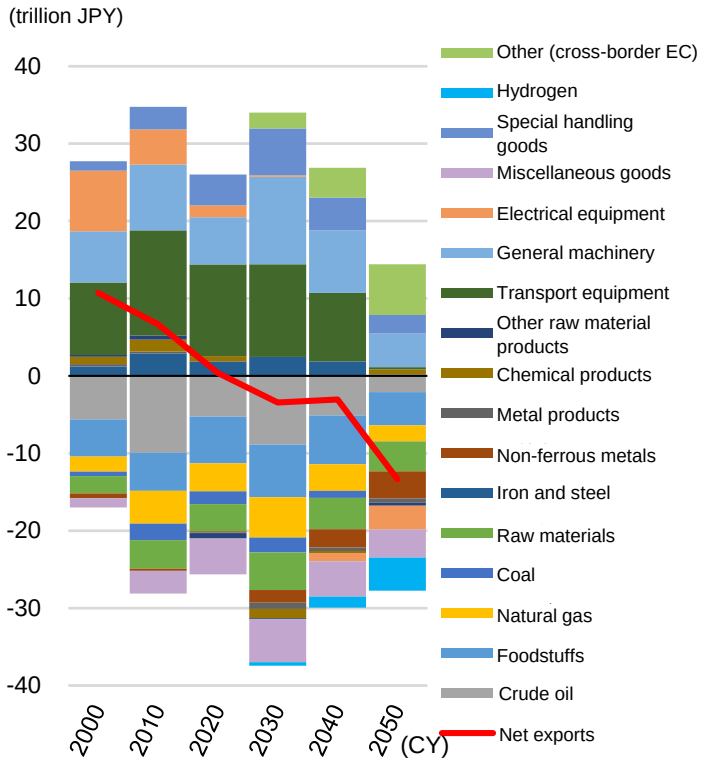
Transport equipment	Automobiles and accessories	Automobiles and their accessories
	Other transportation machinery and equipment	Rolling stock and their parts, ship manufacturing and repair, marine engines, aircraft and their accessories, industrial transport vehicles and their parts and accessories, and other transportation machinery and equipment
General machinery	General purpose machinery and equipment	Boilers and prime movers, pumps and compression equipment, general industrial machinery and equipment, and other general-purpose machinery and their parts
	Production machinery and equipment	Agricultural machinery, construction and mining equipment, textile machinery, machinery for living-related industries, machinery for basic materials industries, metalworking machinery, semiconductor and flat panel display manufacturing equipment, other production machinery and their parts
	Commercial machinery and equipment	Office machinery and equipment, service/entertainment machinery and equipment, measuring instruments and devices, analytical equipment, testing machines, surveying machinery and equipment, scientific and chemistry machinery and equipment, medical machinery and equipment, medical supplies, optical machinery and equipment, lenses, and weapons
Electrical machinery	Electrical machinery and equipment	Electrical machinery and equipment for power generation, transmission, and distribution, industrial electrical machinery and equipment, consumer electrical machinery and equipment, light bulbs and electric lighting fixtures, batteries, applied electronics equipment, electrical measuring equipment, and other electrical machinery and equipment
ICT machinery	ICT machinery and equipment	Communication machinery and equipment and related machinery and equipment, audio and video machinery and equipment, computers and related equipment
	Electronic parts/devices/ electronics circuits	Electronic devices, electronic parts, recording media, electronic circuits, unit parts, other electronic parts/devices/electronic circuits
Chemicals	Chemicals	Chemical fertilizers, inorganic chemical industrial products, organic chemical industrial products, oil and fat processing, soaps, synthetic detergents, surfactants, paints, pharmaceuticals, cosmetics, toothpaste, and other cosmetic preparations, and other chemical industries

Source: Compiled by Mizuho Bank Industry Research Department based on the Surveys for the Financial Statements Statistics of Corporations by the Ministry of Finance

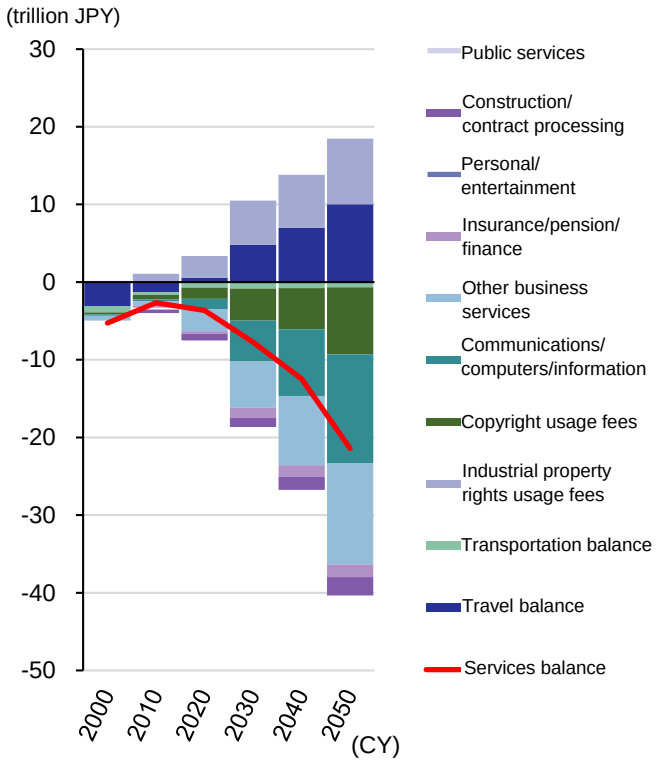
Changes in current account balance breakdown: Are deficits in the trade balance and services balance inevitable?

- The trade balance shows a decrease in exports due to the shift to BEVs and the local production and consumption of automobiles. Imports of fossil fuels decrease while imports of clean energy such as hydrogen increase. Although an increase in cross-border EC increases exports of goods, in general the trade deficit becomes entrenched
- Although the balance of services includes travel income due to increased inbound travel and industrial patents (part of royalties from copyrights, etc.), payments to overseas digital platform providers (the so-called digital deficit[*1]) significantly increase due to the acceleration in digitalization
- The surplus in the primary income balance expands due to the acceleration of moves toward local production and consumption and companies' efforts to capture overseas markets

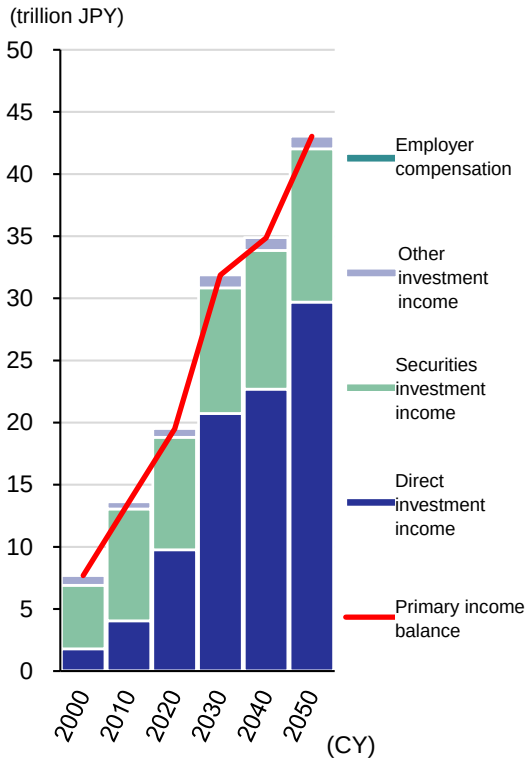
Long-term balance of trade outlook



Long-term services balance outlook



Long-term primary income balance outlook



Note 1: Digital deficit: Computer services + copyright fees + professional/management consulting services
Note 2: For forecasts that extend past 2030, Mizuho Bank Industry Research Department is making forecasts based on the worldview presented in this presentation
Source: Compiled by Mizuho Bank Industry Research Department based on various materials

References

- Hideaki Nakajima(2018), “Rotot--Soreha Jinruino Tekika, Mikataka” [ロボット--それは人類の敵か、味方か]
- Eiji Oguma(2019), “Nihonshakai no Shikumi Koyou・Kyouiku・Fukushi no Rekishishakaigaku” [日本社会のしくみ　雇用・教育・福祉の歴史社会学]
- Rechard Baldwin(2019), “GLOBOTICS Global-ka + Robot-ka ga Motarasu Daigekihen” [GLOBOTICS グローバル化＋ロボット化がもたらす大激変]
- Kazuto Ataka(2020), “”Shin Nihon AI×Data Jidai niokeru Nihon no Saisei to Jinzaiikusei [シン・ニホン　AI×データ時代における日本の再生と人材育成]
- Peter Diamandis(2020), “2030nen: Subete ga Kasokusuru Sekai ni Sonaeyo ” [2030年：すべてが「加速」する世界に備えよ]
- Kohei Saito(2020), “HitoShinse no Shihonron” [人新世の「資本論」]
- Shin Shinohara(2022), “Sonotoki Nihon ha Nannin Yashinaeru?: Syokuryou Anzen Hosyou kara Kangaeru Shakai no Shikumi” [そのとき、日本は何人養える？：食料安全保障から考える社会のしくみ]
- Masato Komiya(2022), “Meta Sangyo Kakumei Metaverse × Digital Twin de Business ga Kawaru” [メタ産業革命 メタバース×デジタルツインでビジネスが変わる]
- Joichi Ito(2022), “Technology ga Yosoku suru Mirai web3, Metaverst, NFT de Sekai ha Kounaru” [テクノロジーが予測する未来 web3、メタバース、NFTで世界はこうなる]
- Hironao Kunimitsu(2022), “Metaverse to Web3” [メタバースとWeb3]
- Matthew Ball(2022), “The Metaverse: Sekai wo Tsukuri Kaeshimono” [The Metaverse: And How It Will Revolutionize Everything]
- Yasufumi Fujii(2022), “Journey Shift Digital Shakai wo Ikinuku Zentei Jouken [ジャーニーシフト　デジタル社会を生き抜く前提条件]
- Naoki Nakamura(2023), “Saisentan no Kenkyu-sha ni kiku Nihonichi Wakariyasui 2050 no Mirai Gijutsu” [最先端の研究者に聞く日本一わかりやすい2050の未来技術]
- Takaki Nakanishi(2023), “Toyota no EV Senso” [トヨタのEV戦争]
- Nihon Keizai Shimbun-sha(2023), “Jinkou to Sekai” [人口と世界]
- David Atkinson(2023), “Kyuuryou no Agekata: Nihonjin Minna de Yutakani naru” [給料の上げ方: 日本人みんなで豊かになる]
- Hamish McRae(2023), “2050nen no Sekai Mienai Mirai no Kangaekata” [2050年の世界　見えない未来の考え方]

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