TOYOTA

Skilled Manufacturing Key to the Future

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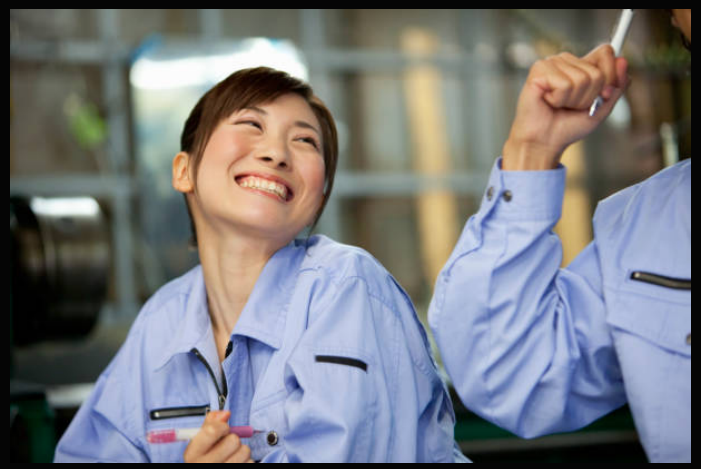
Does this country need manufacturing?
Is manufacturing appealing?

Manufacturing brings happiness, smiles, and joy



Can manufacturing survive
in earthquake-prone Japan?

Isn’t a series of disasters
a sign of emerging weakness?

Isn’t Japan no longer a country in which manufacturing is viable?

NO

A long-cultivated, second-to-none flexibility for turning hardships into strengths makes Japan optimal for manufacturing.

2011
Great East Japan Earthquake

On-site recovery support

2020
COVID-19

Medical gown production support

2021
Disaster recovery

Equipment production support

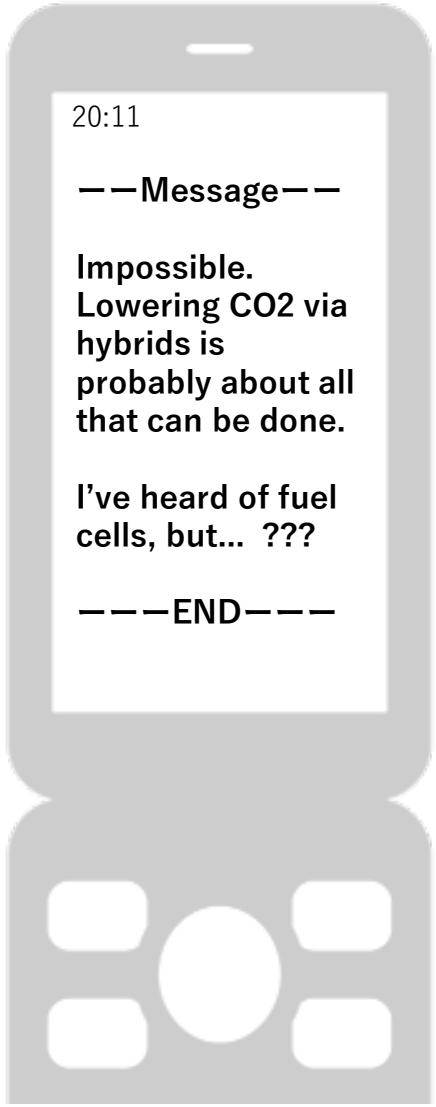
Making things means making people

Japan optimal for manufacturing

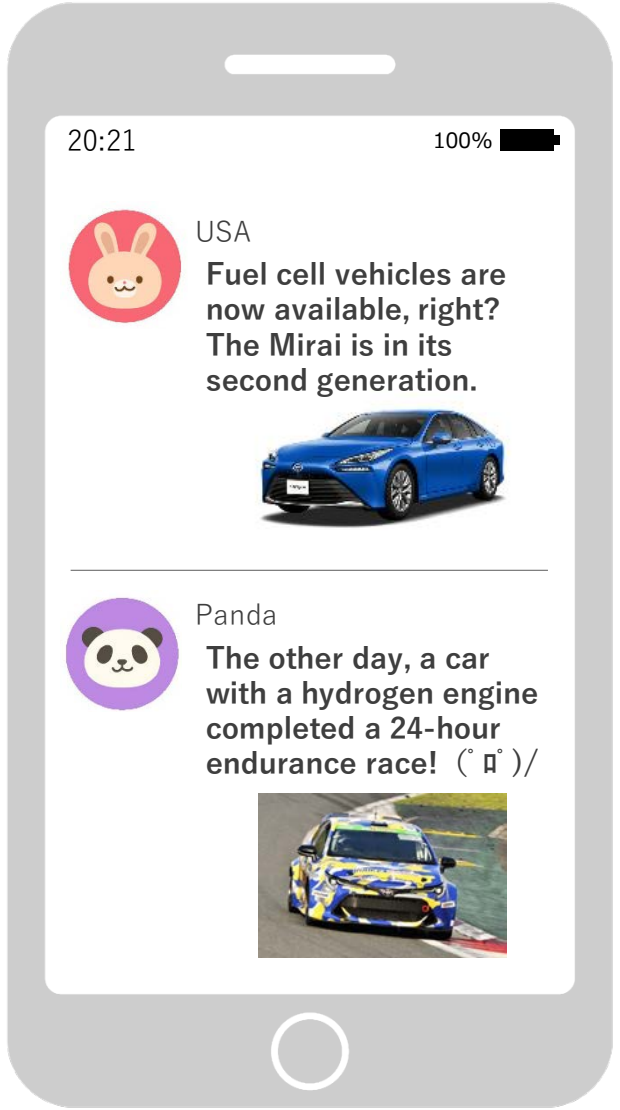
Can manufacturing continue to create new solutions?

Can Japan produce CO2-free vehicles other than battery electric vehicles?

10 years ago



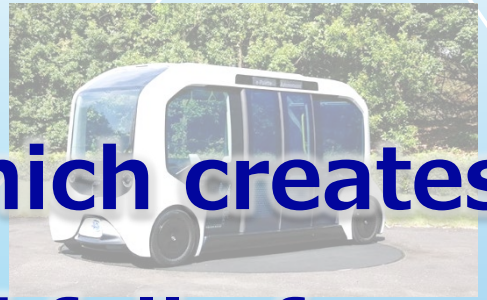
Today



What new creations will come about over the next 10 years?

New creations will surely come to life even beyond that!

Manufacturing, which creates new possibilities, is a growth field full of great expectations!



Willful passion and action can change the landscape of the future

Sharing with you real-life, Toyota stories about the possibilities created by manufacturing with willful passion and action

Skilled Manufacturing Key to the Future

1. Creating vehicle performance at production worksites

1) Car-making supervised by a master driver (Morizo) and professional drivers
2) Achievement of Motomachi Plant & the GR Yaris via a mass-produced vehicle

2. Hydrogen engine the result of combined challenges

1) Thoughts and difficulties of the development & prototyping team
2) Supplier challenges
3) Toyota's challenges

3. Advanced manufacturing for a new era

1) Path toward green plants
2) Development of technologies that embody new ideas
3) *Karakuri* for non-powered devices
4) Collaboration between the latest technologies and TPS

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1) Car-making supervised by a master driver (Morizo) and professional drivers

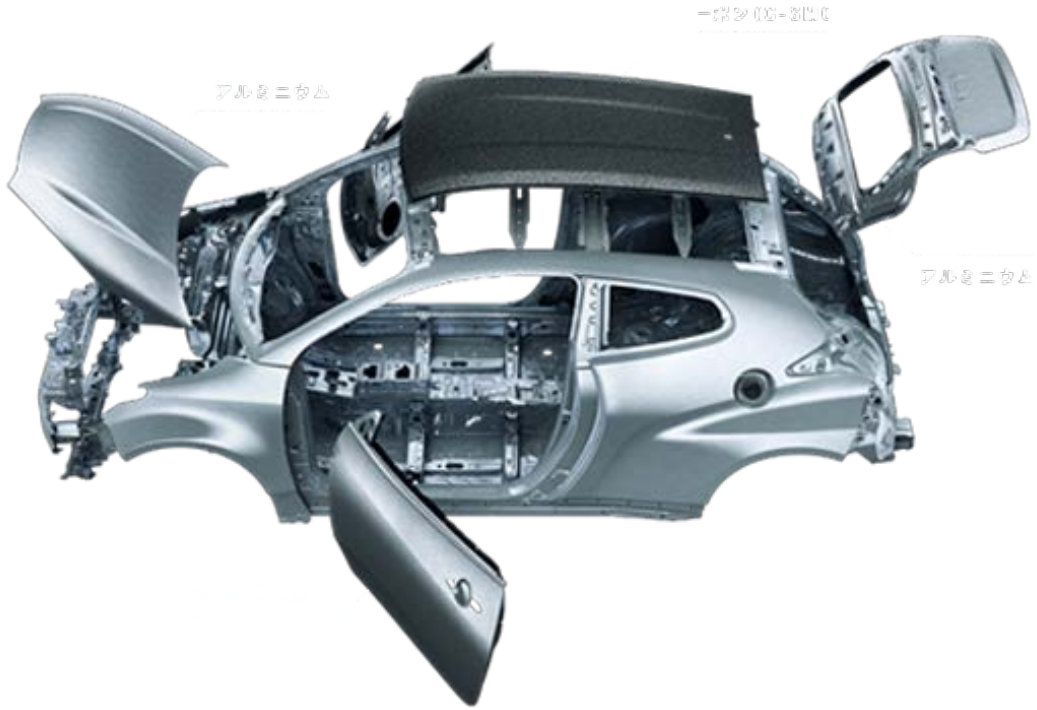
Making ever-better cars based on motorsports

The challenge of building in driving performance during the process

1) Car-making supervised by a master driver (Morizo) and professional drivers

Master driver = Executive chef

Cuisine with a focus on a “before taste”, “middle taste”, and “after taste”

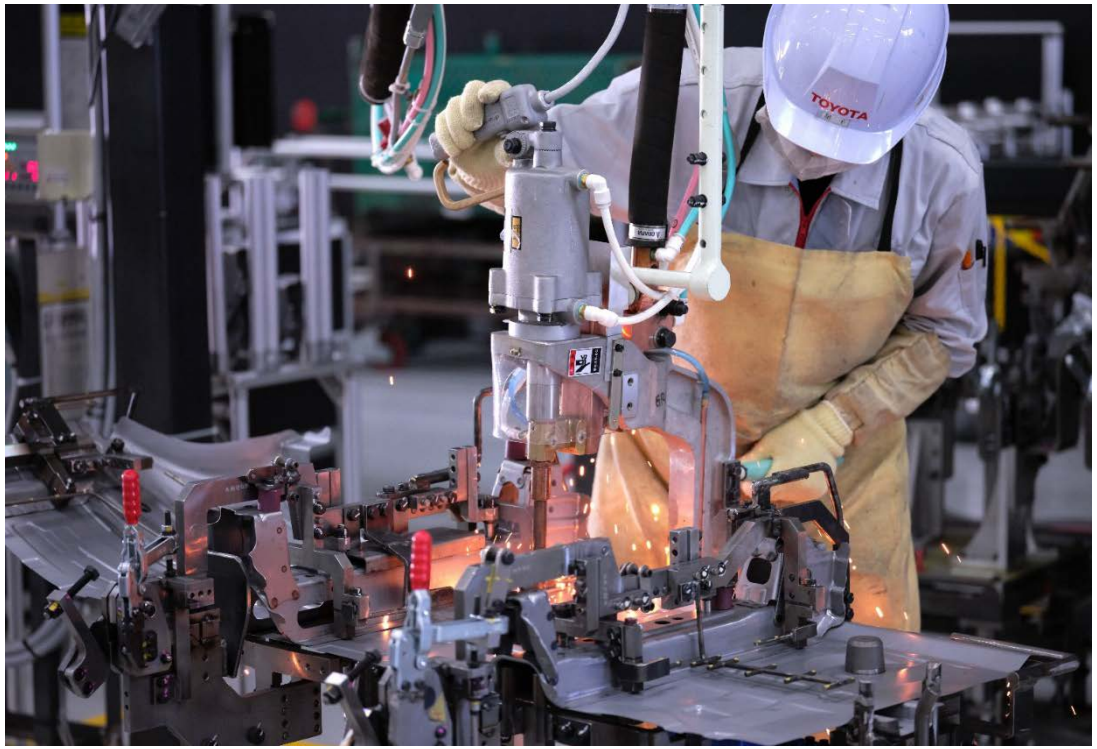


Completion using one’s internal sensors

The existence of a master driver makes exceptional products possible.

2) Achievement of Motomachi Plant & the GR Yaris via a mass-produced vehicle

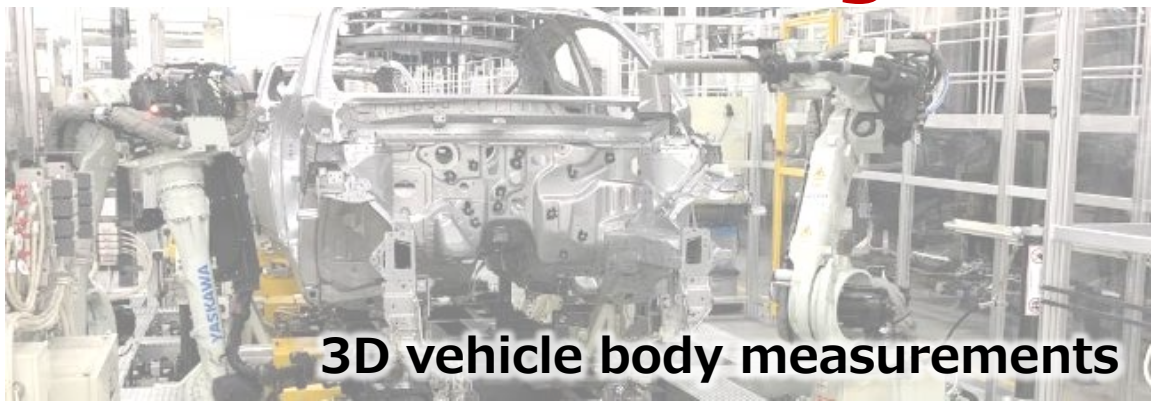
First-rate production line embodies concept of “making ever-better cars”



Building in the body rigidity required of a sports car with craftsmanship

2) Achievement of Motomachi Plant & the GR Yaris via a mass-produced vehicle

First-rate production line embodies concept of “making ever-better cars”



3D vehicle body measurements


Parts selection & assembly based on measurement data


3D suspension parts measurement


Installation in optimal combinations

Manufacturing deviances pre-measured and optimal combinations of parts assembled in unison. ⇒ Best accuracy upon vehicle completion

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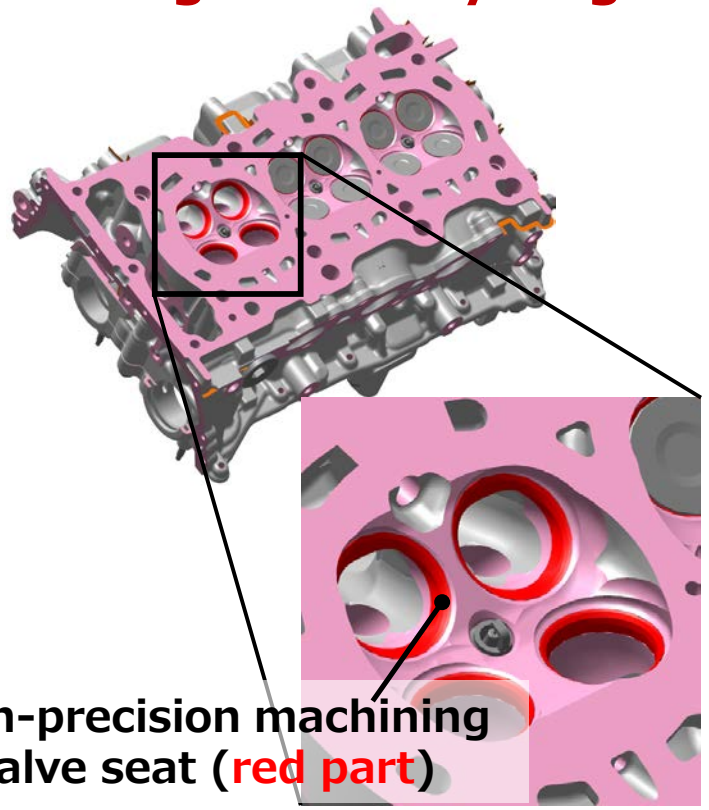
1) Thoughts and difficulties of the development & prototyping team

Mirai hydrogen tank

Fit as many tanks as safely possible within limited space

Mirai tank variations

Changing materials and machining to suit hydrogen



High-precision machining of valve seat (red part)

Hydrogen direct-injection injector

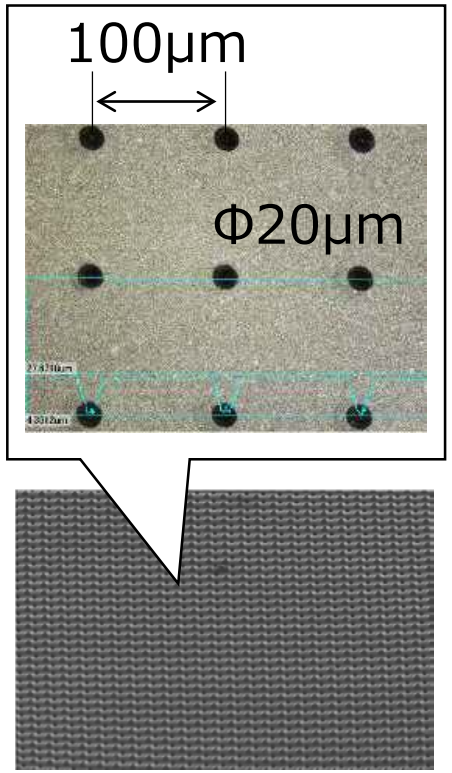
“From liquid gasoline to gaseous hydrogen”—Challenging the unknown

2) Supplier challenges

Ex. 1: Production & equipment manufacturers focused on engine parts

Engine machining technology

Micro-mold processing technology



Refining core machining technologies into specialized machining technologies

2) Supplier challenges

Ex. 2: Gasoline engine injectors → Hydrogen engine injectors

(Combustion injection device)

Gasoline engine

Injector
(Combustion injection device)

From liquid gasoline to gaseous hydrogen
↓
Professional skills & passion
↓

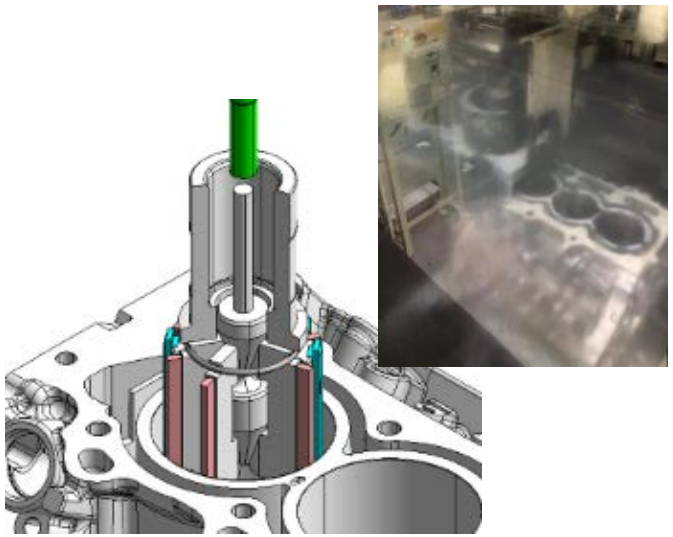
Coating technology
appropriate for a hydrogen environment
Ultra-high precision injection hole processing
appropriate for gaseous injection

Hydrogen direct-injection injector

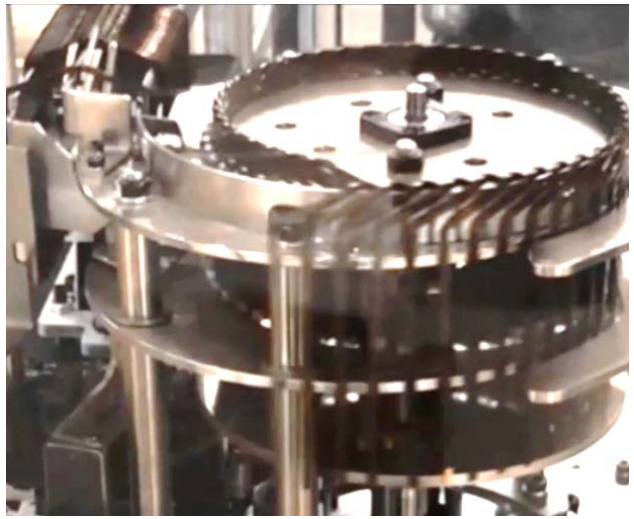
Hydrogen engine injectors the result of skills and technologies cultivated via gasoline engines

3) Toyota's challenges

Round-bore technology for engines



High-speed assembly technology for electric motors



FCEV hydrogen tank production equipment

Refined via various power units

3) Toyota's challenges

FCEV technologies

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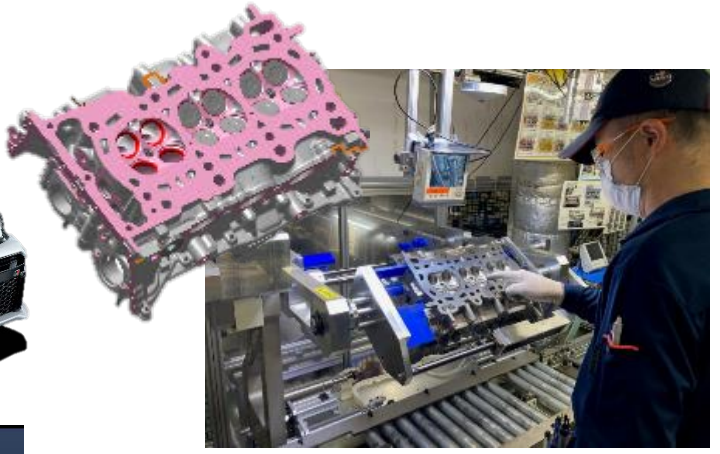
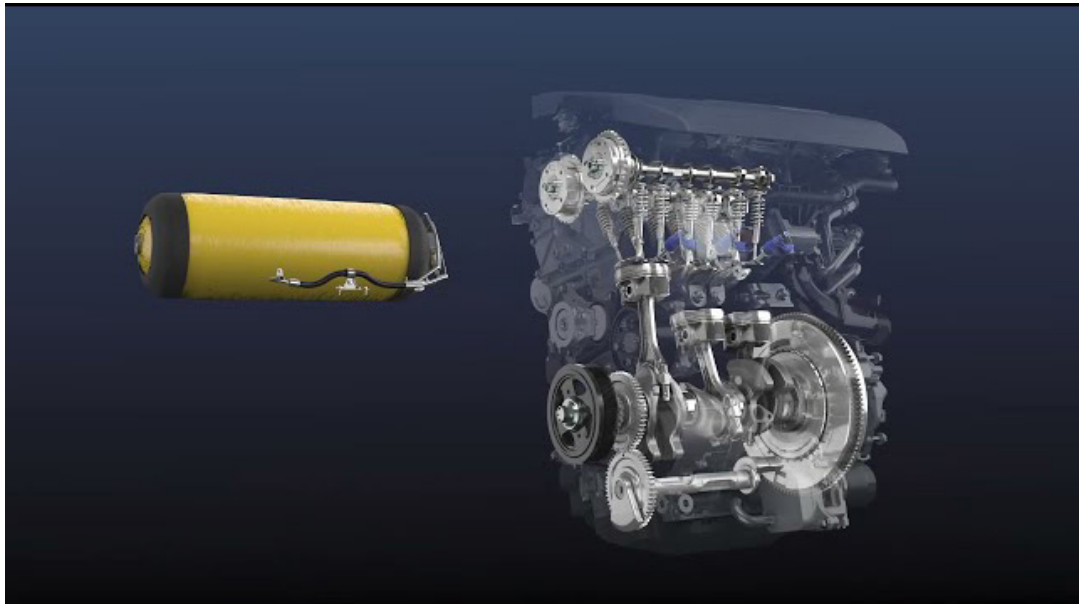


Engine technologies



Hydrogen engine built using FCEV & engine manufacturing technologies

First step toward expanding options (for carbon neutral) fuels for the future

May 23
Super Taikyu
Series race

Proved the possibilities

A variety of options

Door opened to new future for engines and industry overall

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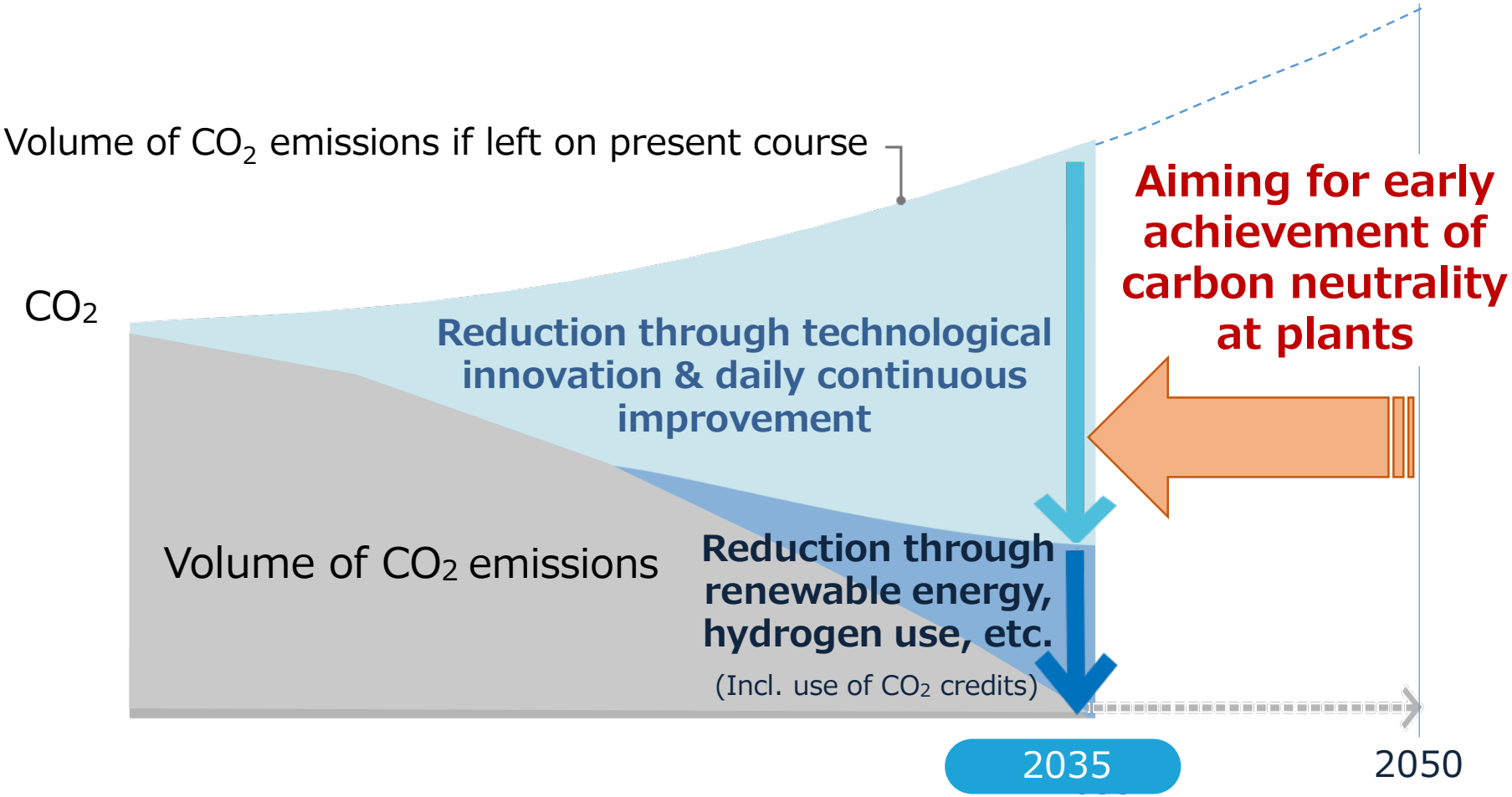
1) Path toward green plants



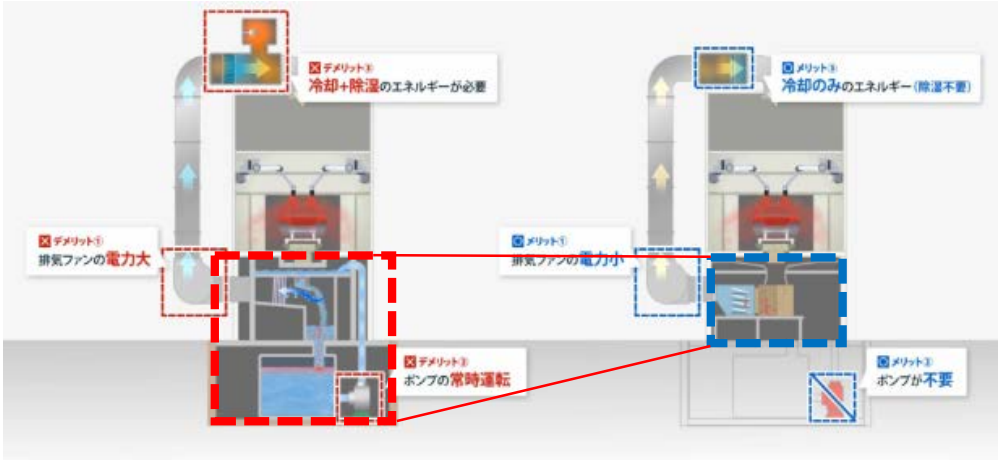
Aiming for early achievement of carbon neutrality at plants

Striving for carbon neutrality presents an opportunity to fundamentally innovate manufacturing

2) Development of technologies that embody new ideas

Ex. 1: Splatter-free painting

(Coating efficiency: 70%)(Coating efficiency: 95%)



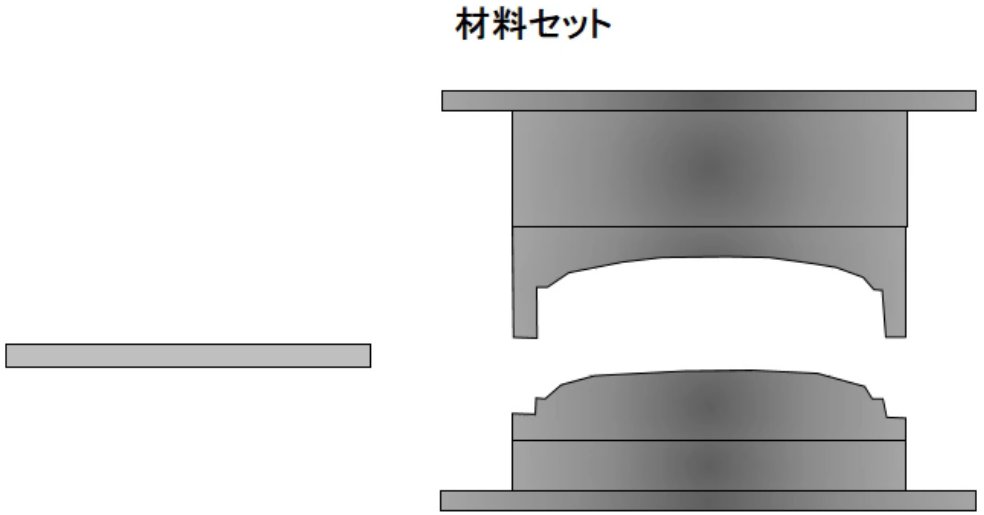
Paint booth

Achieving maximum coating efficiency with minimum amount of paint

2) Development of technologies that embody new ideas

Ex. 2: Elimination of paint process (in-press coloring)

Point : Press molding + In-mold coloring = In-mold coating



Using combinatorial technologies to inject paint into the mold, thus eliminating the painting process

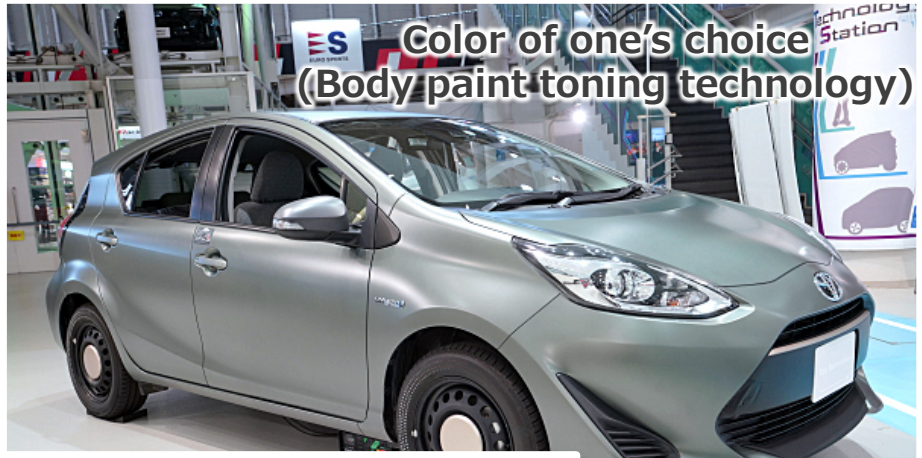
2) Development of technologies that embody new ideas

Ex. 3: Elimination of paint (use of adhesive film)

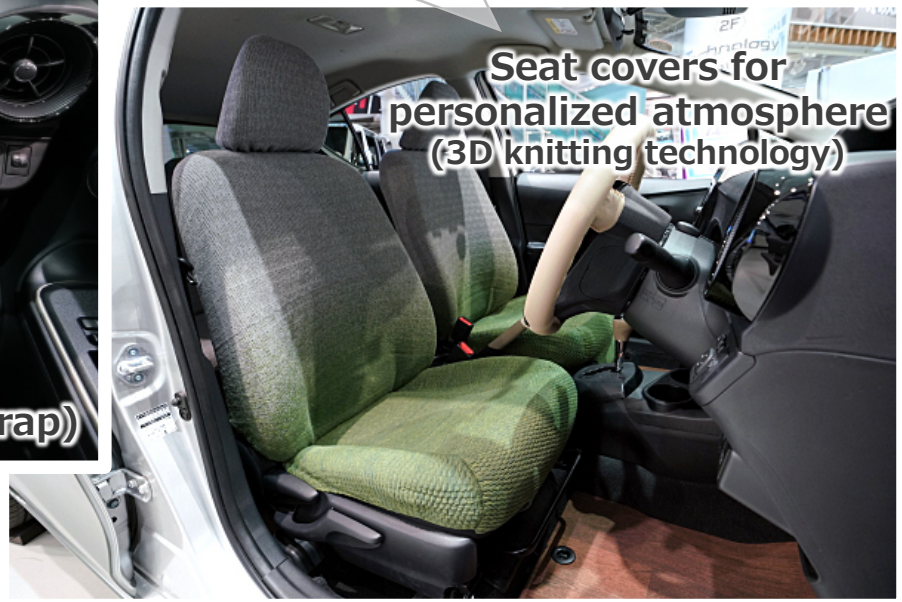
No-paint adhesive film ⇒ Carbon-neutral and exciting for customers

2) Development of technologies that embody new ideas

Ex. 4: Refining used KINTO vehicles



On-demand production using a flat knitting machine and recycled yarn



Renovation technology for providing customers with their own, unique vehicles, contributing to the realization of a recycling-oriented society

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3) ***Karakuri*** **for non-powered devices**
4) Collaboration between the latest technologies and TPS

3) *Karakuri* for non-powered devices

***Karakuri*...**
the combination of simple
fundamental movements

Source: Excerpted from: https://www.molem.jp/molen-1

Toyota's Honsha Plant

Basic Toyota Production System line

Ex.: *Karakuri* device for pressure-fitting oil seals

Must properly work for the next action to occur

Easy to detect problems without relying on sensors

Developing human sensibilities and equipment by going back to mechanical-action *karakuri*

3) *Karakuri* for non-powered devices

***Karakuri* = For the ultimate in carbon-neutral devices**

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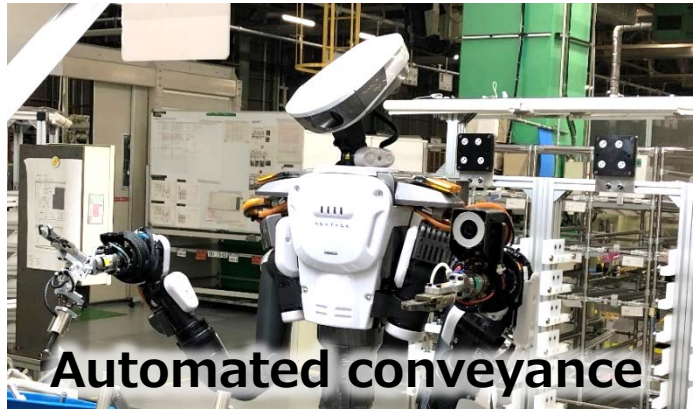
4) Collaboration between the latest technologies and TPS



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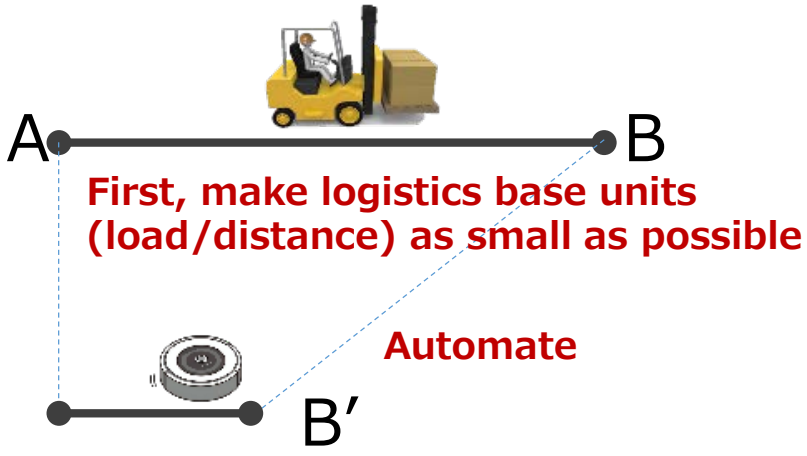
Continuous improvement unique to Toyota

⇩

Do not transport



Concept to be applied to Woven City

4) Collaboration between the latest technologies and TPS

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Continuous improvement unique to Toyota

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Do not produce defects

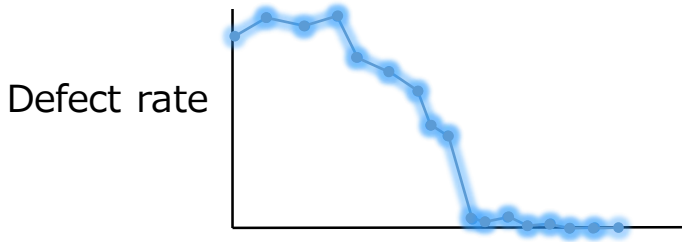
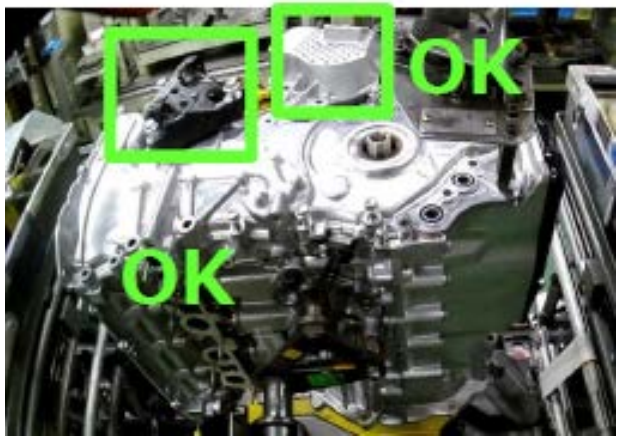


Image of automated inspection

① Automated judgement
→ Workforce flexibility



② Data analysis
→ Less defective work

Not about automating inspection but about improving the essence

4) Collaboration between the latest technologies and TPS

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Continuous improvement unique to Toyota

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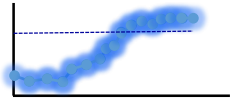
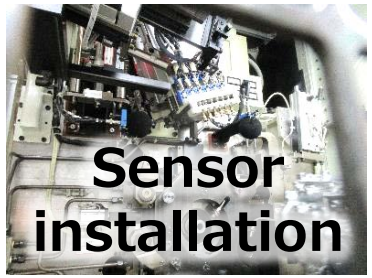
Don't turn people into machine-keepers

Simple, slim, *karakuri*

Operational rate





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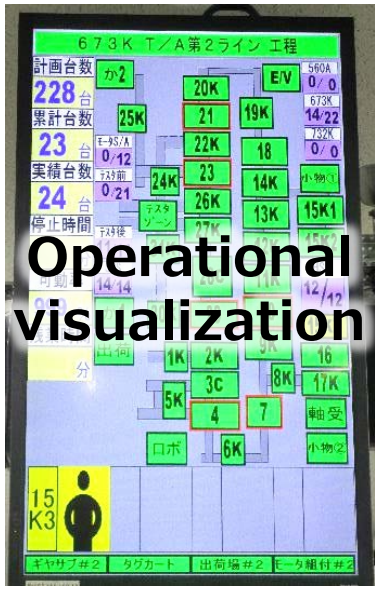

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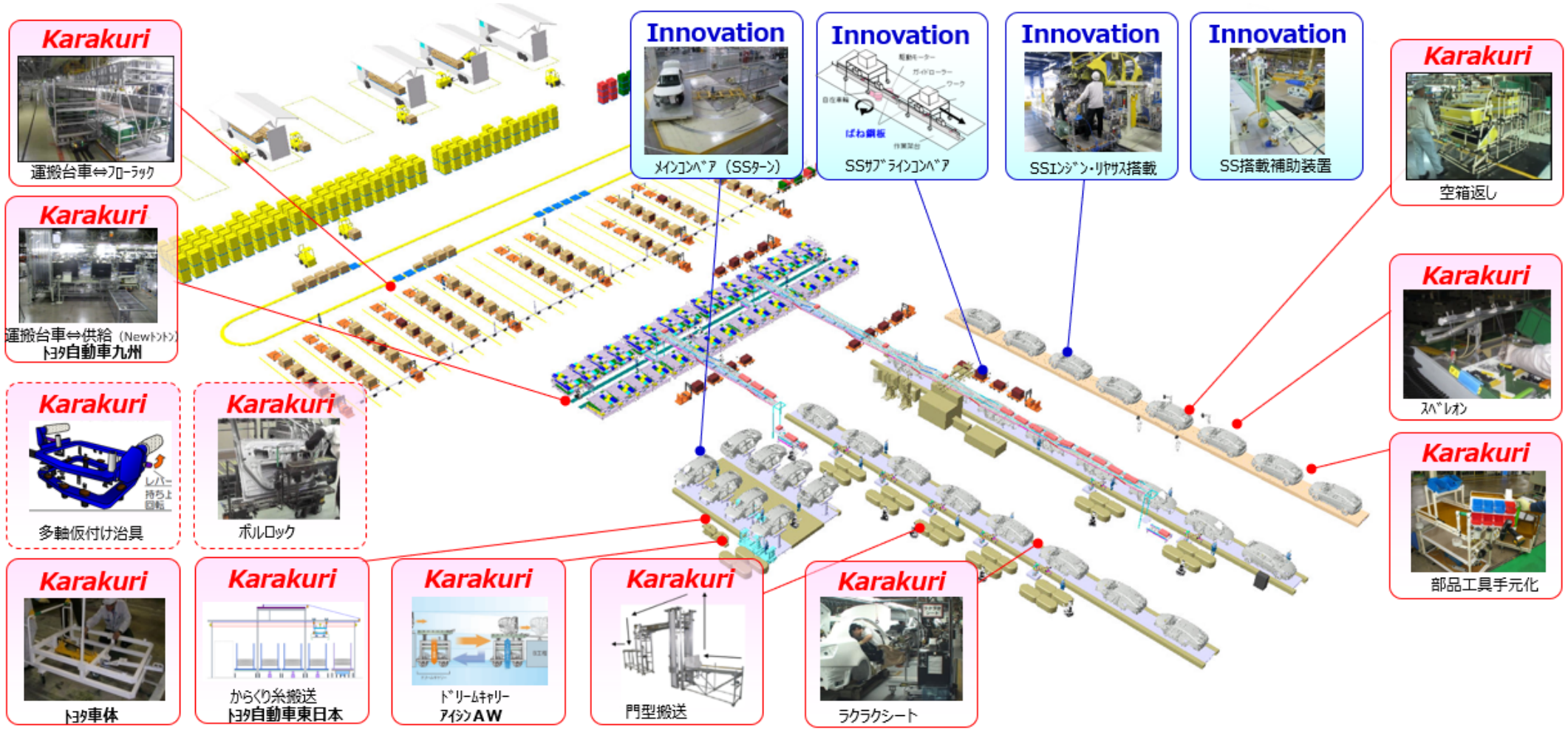
Visualization using the least number of sensors and only where needed

Aiming to create equipment that does not break down

4) Collaboration between the latest technologies and TPS



Creating advanced production lines by combining *karakuri* & innovation


Conclusion