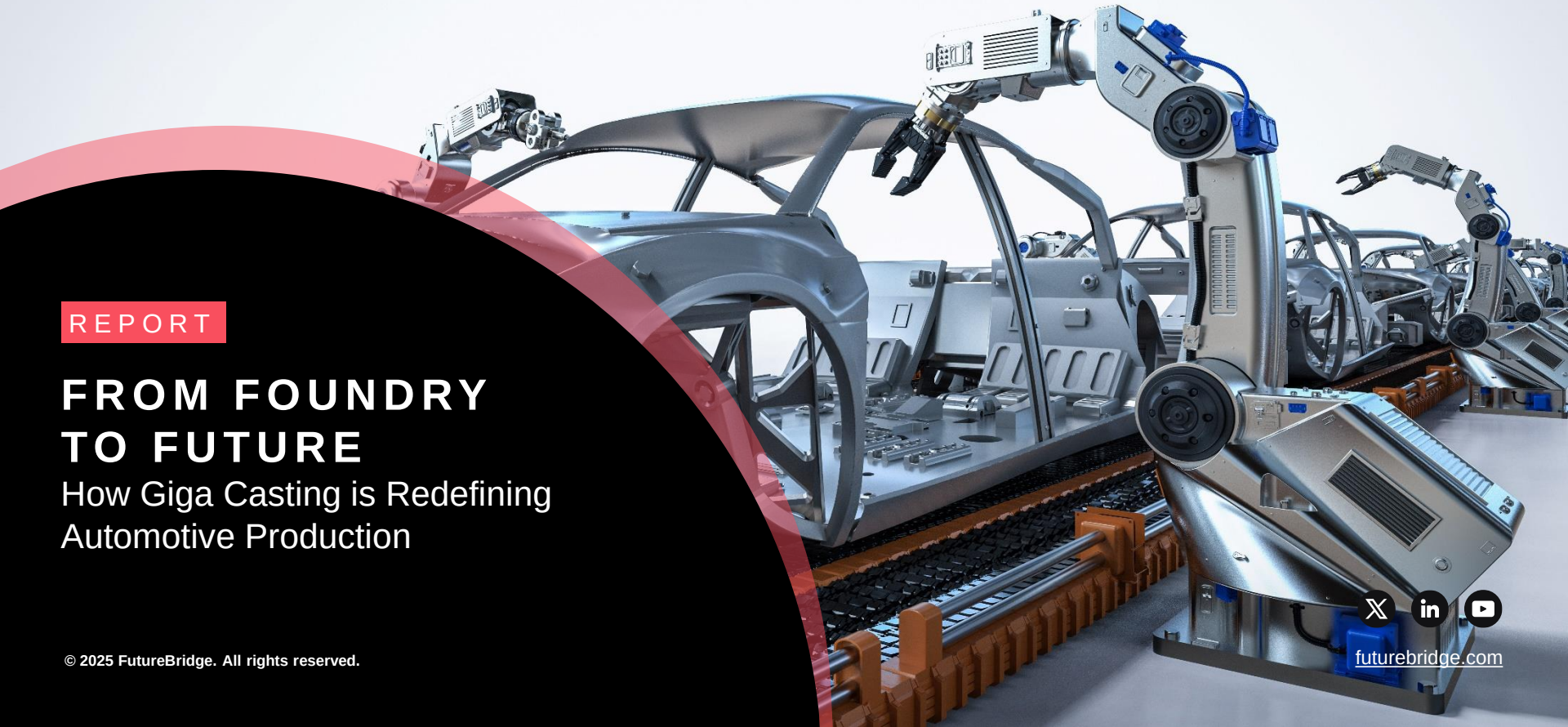
FutureBridge



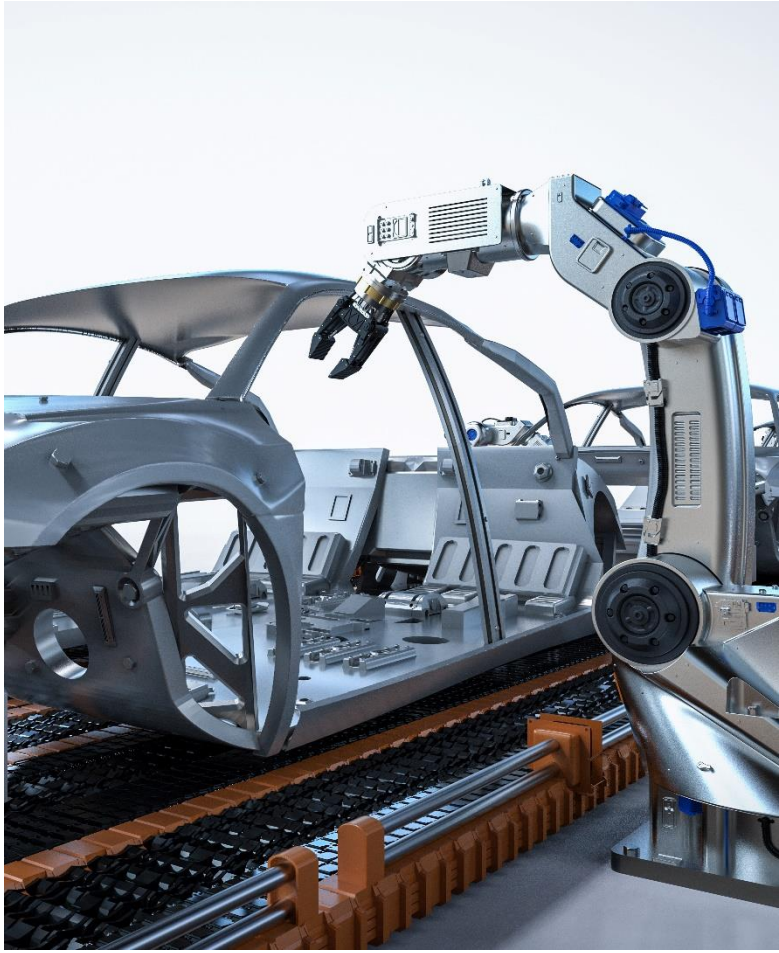
REPORT

FROM FOUNDRY TO FUTURE

How Giga Casting is Redefining Automotive Production

futurebridge.com

CONTENTS



01 Introduction to Giga Casting

- An overview
- Evolution of giga casting

As the global transition to EVs accelerates and manufacturing efficiency gains importance, giga casting is set to play a pivotal role in transforming the future of automotive production

Giga casting, a revolutionary technique in automotive manufacturing, is a process of making large and complicated casting structures in a high-pressure die-casting machine that injects molten aluminum into casting molds

Leading the Way: How Tesla's Giga Casting Revolution is Inspiring the Industry

Traditionally, a car body consists of over a hundred stamped metal parts welded together. By minimizing part counts, The company achieved significant cost reductions and streamlined production, contributing to its industry-leading profitability.

- Single rear component in Model Y reduced related **costs by 40%**
- Model 3's integration of front and rear components led to the **removal of 600 robots from the assembly line**
- This approach **lowers vehicle weight**, crucial for EVs with heavy battery packs

What does the future hold?

- Established players like **Toyota, Volvo, Hyundai, GM and VW** exploring its potential to transform manufacturing processes
- The integration of giga casting and hybrid manufacturing is set to become the norm in EV production, driving efficiency and reducing complexity
- Transition from “1+3” piece concept to “3+1” piece concept may happen in the next 6-8 years

The big ideas behind giga casting: what the industry is focusing on

Expert's Viewpoints

*"Giga casting reduces vehicle production time by up to **30%**, streamlining assembly and boosting throughput at scale. This is a **game-changer** for EV manufacturing."*

Chief Production Engineer: Tesla

*"With fewer individual parts, **giga casting** drastically **cuts down on defect rates** and enhances structural integrity, setting new industry standards for durability "*

Operation Head: FORD Motors

*"Giga casting is reducing our reliance on traditional welding and joining techniques, but it's still early days. The long-term impact on **vehicle lifecycle costs** and **repairability** is something we'll need to monitor closely."*

Senior Director: BYD

Tesla's early success with giga casting has inspired established players to strategically invest in this technology, aligning with their long-term objectives of operational efficiency and innovation

In 2018, Tesla invested heavily in massive die-casting machines - **Giga Presses. Tesla** engineers worked with **IDRA Group and LK Technology** to co-develop and refine the machine's specifications and functionality

Giga Casting Technology & It's Evolution

2018

The Giga Press was developed through a collaboration between **Tesla, IDRA group, and LK Technology.**

2019

Tesla persevered, refining the technique and reaping the benefits**: reduced weight, enhanced strength, and streamlined assembly**

2020

Toyota and General Motors initially expressed skepticism. However, the allure of cost reduction, efficiency gains, and lighter EVs was undeniable

2021

Toyota announced Giga casting adoption for future EVs, aiming for a **20%** weight reduction and faster production

Tesla plans on using the 8000-ton Giga Press to cast the **Cybertruck**

Tesla & IDRA Planning Massive Giga Press For Compact Car

2022 2023

- **Hyundai** unveiled plans for Giga casting its electric pickup truck, the **Ioniq**
- **Volvo** joins the Giga casting Revolution With Two New **9,000-Tonnes** EV Giga Presses
- **NIO** aims to use mega-casting for **ET5** rear sub-frame and possibly for the **ET7** sedan
- **XPENG** aiming to use mega-casting for the **P7** wing edition.
- **General Motors** plans to use Giga casting for its **Cadillac Celestiq luxury EV**
- **General Motors** snatches key Tesla Giga casting supplier (**TEI**)

2025 & Beyond

While luxury and SUV segments led adoption, compact EVs and light commercial vehicles will integrate giga casting to achieve cost parity with ICE vehicles

By 2030, OEMs will move beyond rear underbody castings to adopt 3+1 architectures and full-frame casting, reducing assembly complexity and improving vehicle rigidity

Source: FutureBridge Analysis

02 Giga Casting Accelerating the Shift to Electric Mobility

- OEMs adoption landscape
- Tailwinds fostering its growth
- Various concepts of giga casting
- Push for “localization” – Supply chain resilience

Emerging Automotive EV OEMs are adopting giga casting to better position themselves to compete in the evolving landscape of electric vehicle manufacturing

TESLA MOTORS


Model Y; 2T


MY RWD; 1.7T


Cybertruck; 3T

Powertrain Focus:

Vehicle Segment Focus:

XPENG


G6; 2.2T


X9; 2.2T

Powertrain Focus:

Vehicle Segment Focus:

Rear Lower Body manufactured by **Giga Casting**

NIO


ES8; 2.1T


ES6; 2.3T


ET5; 2.5T

Powertrain Focus:

Vehicle Segment Focus:

ZEEKR


9; 2.8T

VOLVO


M90; 2.9T

mi


SU7; 2.1T

Powertrain Focus:

Vehicle Segment Focus:

Passenger Vehicle: Sedan

Passenger Vehicle: SUV

Electric Vehicle

Source: News Articles, FutureBridge Analysis

FutureBridge Insights

Giga casting helps in **weight reduction by 10% - 20%** based on the OEM's approach

PV segment is focused by OEMs due to higher **production volumes** for a quicker **break-even**

2.5 ton is preferred weight category to achieve high **weight reduction** of **EVs** and overall **cost savings**

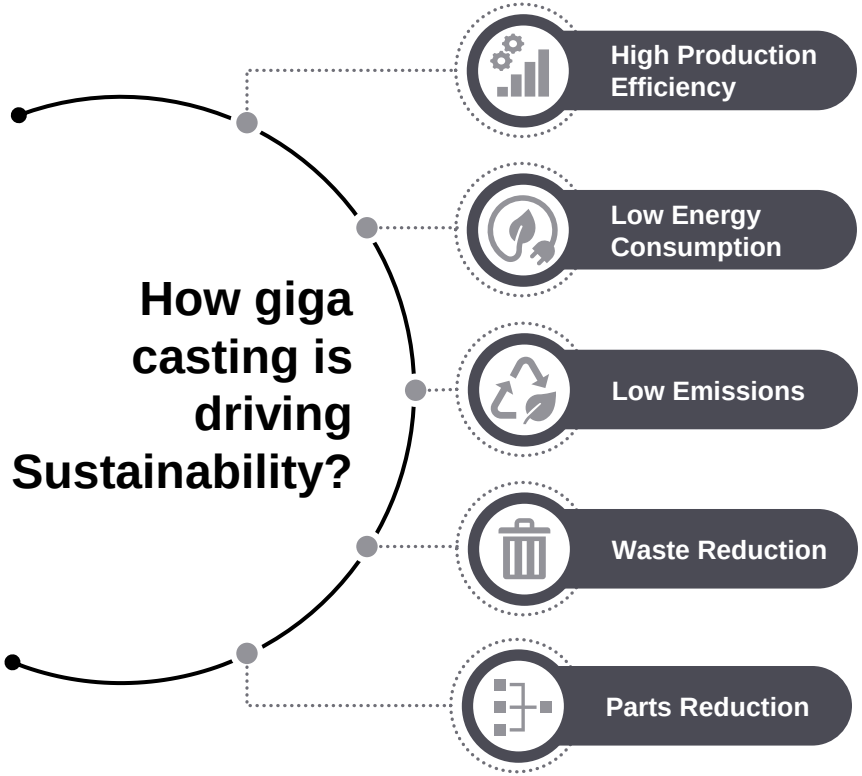
FutureBridge Perspective

SUV and sedan adoption proves viability, but standardizing giga casting across multiple models will unlock true cost benefits

OEMs should explore modular giga casting architectures that can be adapted across various model segments without extensive retooling

Giga casting gives automakers a clear advantage by simplifying production, cutting costs, reducing emissions, and boosting efficiency, all while improving profitability

How giga casting is driving Sustainability?



Giga casting achieves **27.8 jobs per hour**, outperforming steel stamping at **24.4,** while reducing labor and indirect costs. The streamlined process, with fewer parts, simplifies assembly and quality control, **requiring fewer operators** on the production line.

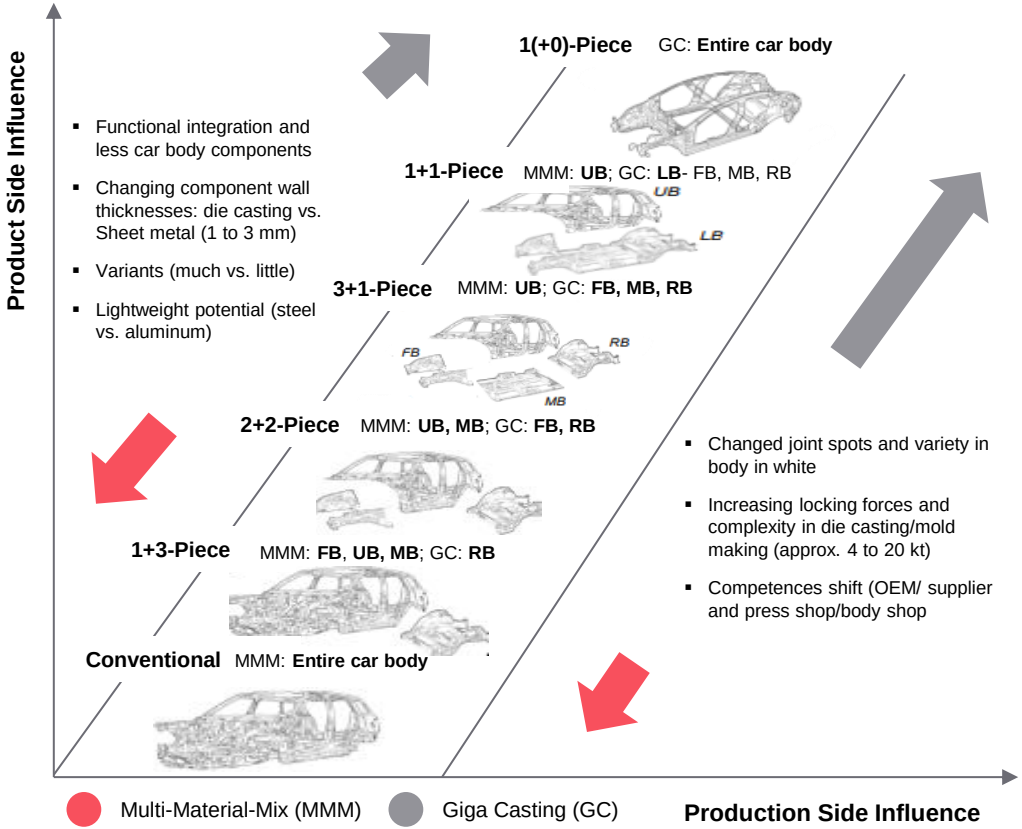
Giga casting requires significantly **less energy** than traditional manufacturing methods. Giga presses offer energy savings up to **50%,** thereby lowering **carbon emissions**.

CO2 emissions are lowered by **15-20%** due to the elimination of energy-intensive processes such as welding and riveting.

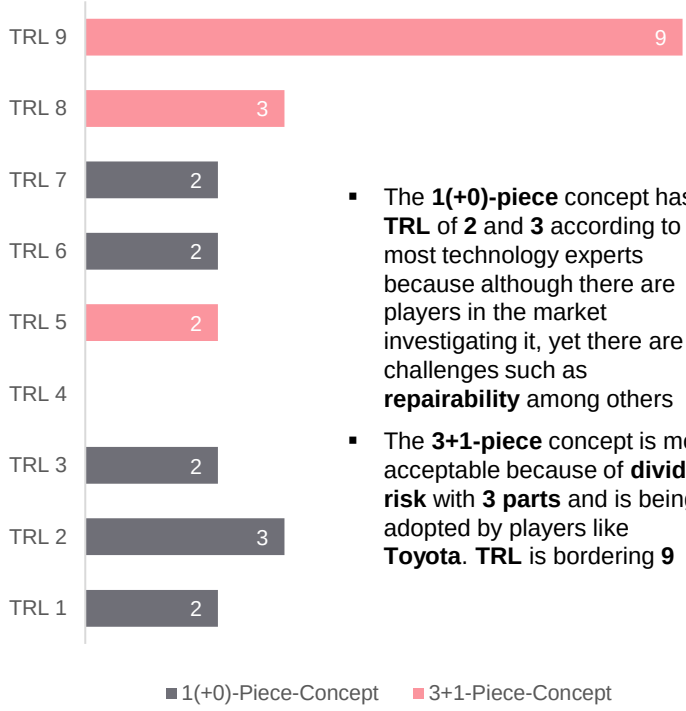
Giga casting consolidates numerous components into a single, large part, **driving material efficiency**. Compared to traditional stamping, which can result in up to **30%** scrap, giga casting **optimizes aluminum use**, significantly reducing waste.

Each giga casting reduces the part count by **30 to 40 components** compared to conventional stamped construction. This streamlining **simplifies production, lowering complexity** in assembly, minimizing the need for additional fasteners or joints, and improving overall manufacturing efficiency

1+3-Piece concept is widely used due to initial concerns with giga casting, but with proven benefits like waste reduction and faster production, OEMs are expected to shift towards the 3+1-Piece concept

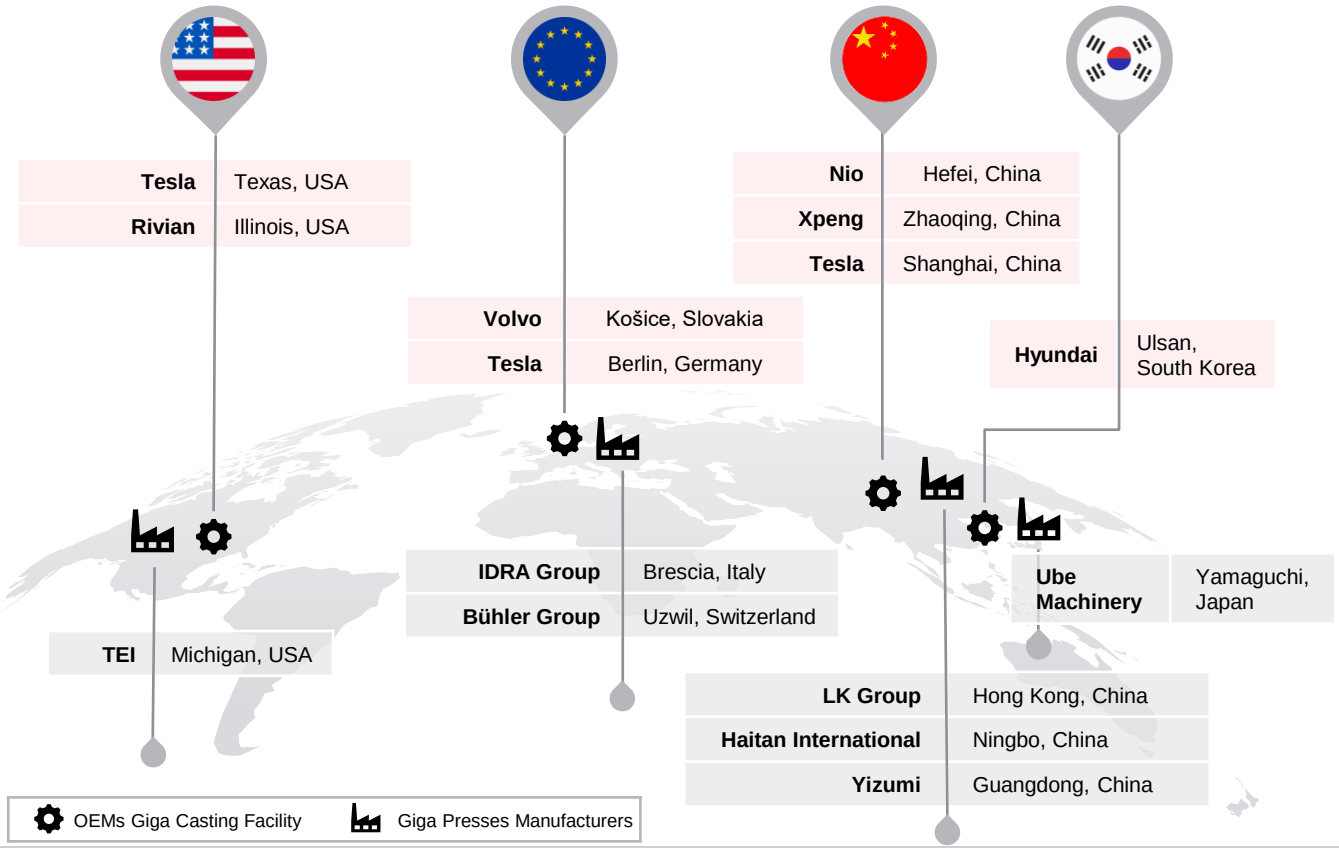


Experts' Opinions on estimation of TRL for giga casting (3- and 1- Piece) and it's feasibility for commercialization



- The **1(+0)-piece** concept has a **TRL** of **2** and **3** according to most technology experts because although there are players in the market investigating it, yet there are challenges such as **repairability** among others
- The **3+1-piece** concept is more acceptable because of **divided risk** with **3 parts** and is being adopted by players like **Toyota**. **TRL** is bordering **9**

Increasing “localization” is pushing for synchronization between production and consumption centers thus maintaining supply chain resilience



FutureBridge Perspective

From APAC Hub to Global Expansion

- China leads in giga press manufacturing, but IDRA, Buhler, and TEI are accelerating regional growth in Europe & North America

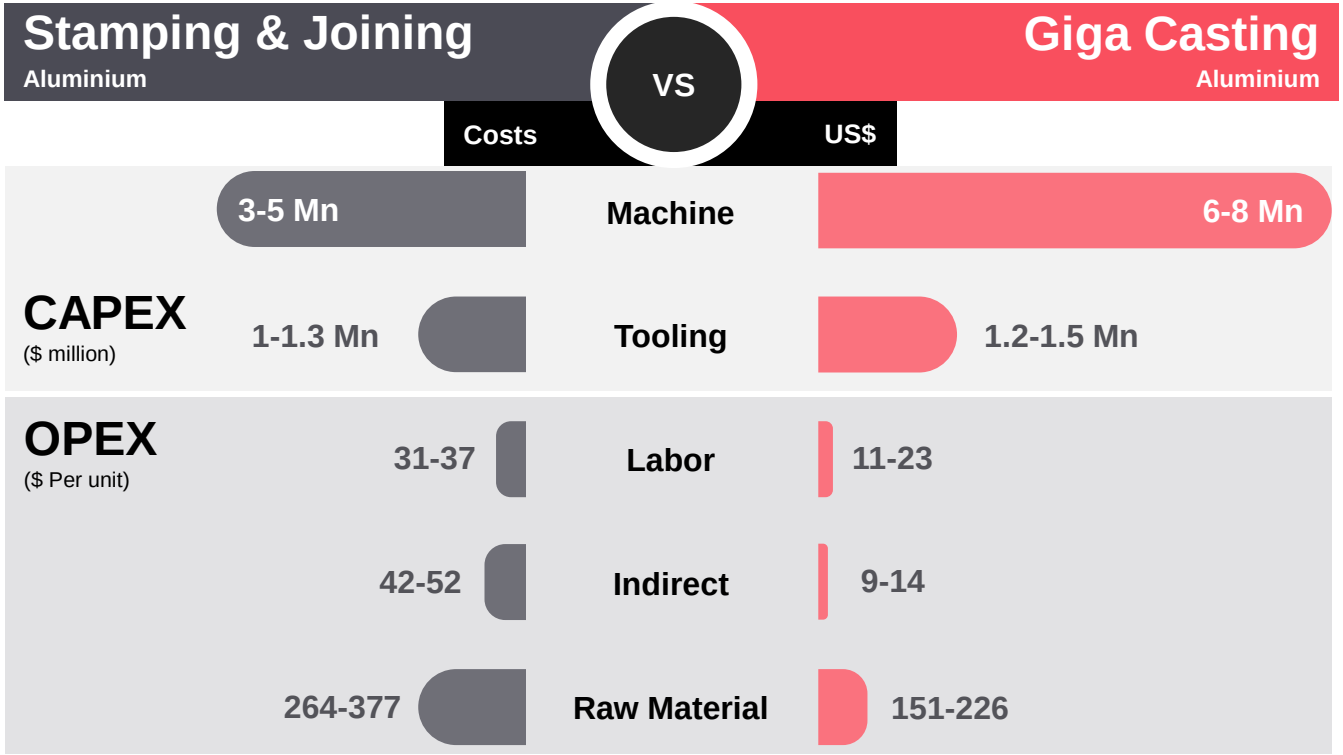
Localization: The Next Competitive Edge

- With logistics costs adding 10-15% on the CAPEX, “localization of production and consumption centers” will play a key role in defining the future manufacturing landscape
- This will lead to the rise of regional giga press manufacturers, enabling large scale casting operations thus streamlining traditional supply chain by integrating tier suppliers

03 Smart Investment for Long-Term Profitability

- CAPEX and OPEX comparative analysis
- Repairability Challenges and Workarounds

Although giga casting requires a ~55% higher initial CAPEX it benefits from ~45% lower OPEX, making it an effective choice for EV mass production in the long run



*Above numbers are calculated assuming manufacturing of rear underbody for 100,000 EV units/year

FutureBridge Perspective

A phased transition strategy is critical

- Instead of an all-in shift, OEMs should prioritize giga casting for high-volume, cost-sensitive models while gradually scaling to full-body casting architectures

OEMs must shift cost evaluations from CAPEX-focused to lifecycle economics

- Short-term investment concerns must give way to long-term cost leadership, where lower OPEX and material efficiency make giga casting a non-negotiable for EV mass production

Concerns about repairability, the complexity of replacements, and potential defects continue to pose challenges, impacting the current adoption of giga casting technology

Single Part, Big Impact

- Giga Casting integrates multiple parts into a single unit, which increases the complexity of repairs
- This added complexity can lead to longer vehicle downtime and increased labor costs

Complex Replacements

- Higher labor costs for Giga Casting repairs could significantly impact overall maintenance budgets, especially for frequent repairs driven by need for specialized skills

Large Cast, Larger Defects

- Imperfections in a single casting could lead to weaknesses in larger portions of the vehicle structure

FutureBridge Perspective

20-30%	Longer repair times than traditional methods
1.5X	Labor Costs
2X	Parts replacement cost

Concerns raised by FEDA

In 2023, The French Automobile Distribution Federation (FEDA) warned that giga casting technology in vehicle production could **increase repair costs** and create environmental challenges due to **difficulty recycling large parts**. They urged the government to evaluate these risks.

Despite these challenges, repair costs are unlikely to hinder giga casting adoption, as OEMs are proactively enhancing repair techniques and bolstering supply chain resilience

Giga Casting Benchmarked Against Stamping [for integrated rear parts]

10-50 mm crack	10-30 mm crack
▪ Welding ▪ Bolting ▪ Patching	▪ Welding

Repair Feasibility

US$ 100–600	US$ 950–1500
▪ Aftermarket price per part	▪ Aftermarket price per part

Replacement Feasibility

Traditional Stamping | Giga Casting

Repair feasibility of giga casted parts is **33% less** compared to conventional parts.

Giga casting **complicates replacement** as instead of single part whole casting is replaced.

Key developments by stakeholders to mitigate aftermarket challenges in giga casting

Efforts being made to increase ease of availability for low-cost replacement parts in the market

TESLA | ZEEKR | TOYOTA

Strategic partnerships executed for investigation of new repair techniques

TESLA | Thatcham Research – Automotive Risk Intelligence

FutureBridge Insights

Investment-Driven Innovation Will Solve Repair Feasibility

- As OEMs and equipment manufacturers ramp up giga casting investments, expect advancements in repairability, aftermarket solutions, and localized supply chains, strengthening sustainability and cost competitiveness

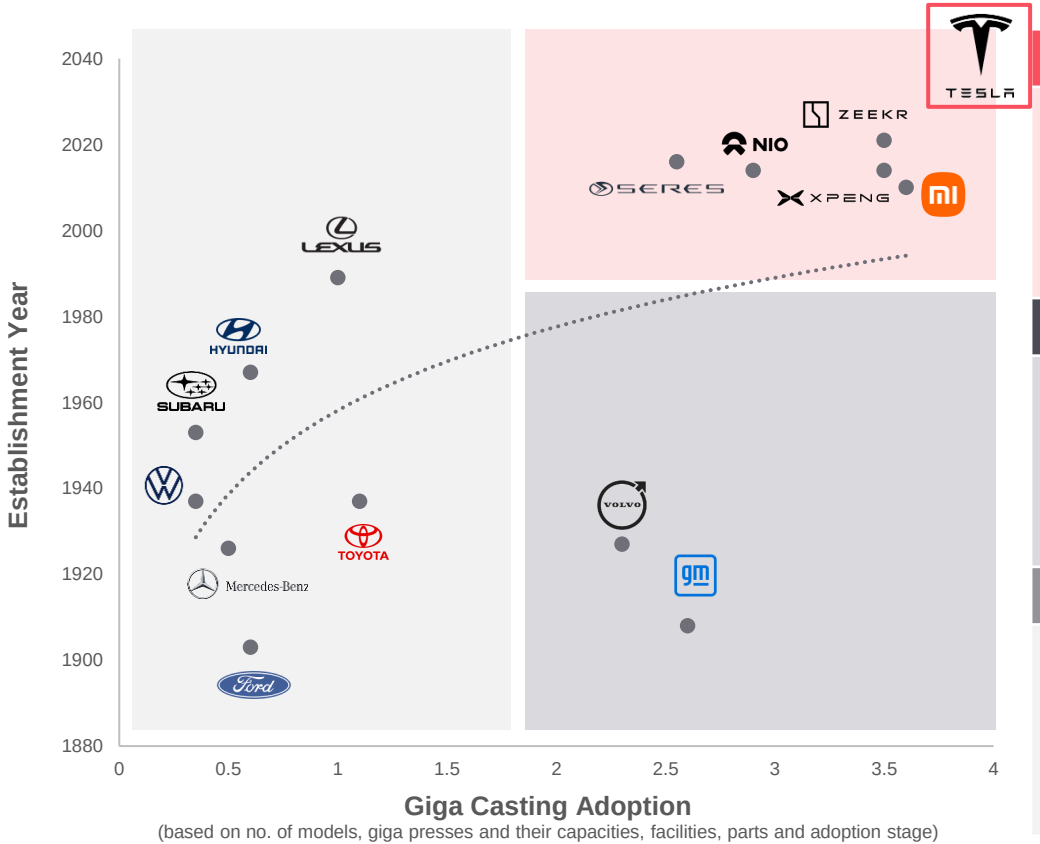
Tracking Giga Casting Adoption is a Competitive Imperative

- FutureBridge recommends stakeholders closely monitor how Tier 1 suppliers and OEMs scale giga casting, as early adopters will set industry benchmarks and define future strategic opportunities

04 The Giga Revolution: Strategies for Success

- Start-ups vs Legacy: Race towards competitive edge
- Disruption in the value chain
- Future roadmap

Giga Casting is reshaping the automotive landscape, with newer companies leading the charge and established players adapting to remain competitive



"Giga" Leaders

- Tesla, pioneer in giga casting, started the industry trend
- Chinese EV start ups such as Zeker, Nio, and Seres, greenfield setups, production lines optimized for Giga Casting
- Lack of legacy systems giving them greater flexibility and efficiency

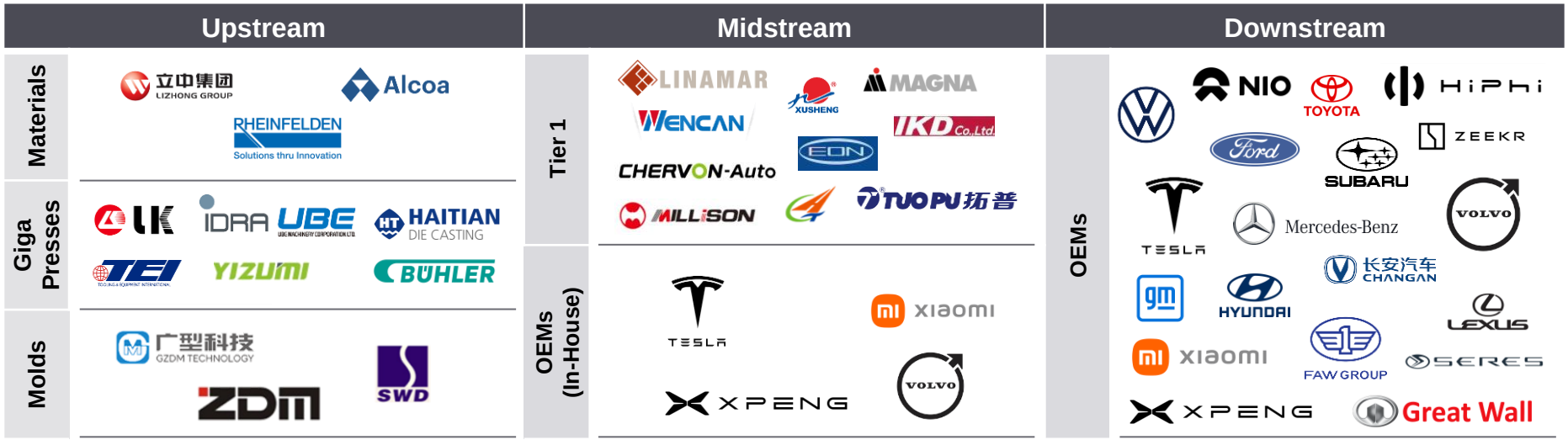
Forerunners

- Established companies including Volvo and GM, started greenfield production of EVs using giga casting
- Balancing innovation with tradition, leveraging existing resources and expertise

Seekers

- Larger, established companies such as Hyundai, VW, and Toyota are exploring giga casting potential through pilot projects and collaborations with Tier 1 suppliers
- Scale and resources can give them a competitive edge in the long run

Although in-house development is largely followed by the “Giga Leaders”, the manufacturing will ultimately shift to “Tier” players owing to mass production and scalability requirement



FutureBridge Perspective			
	Upstream innovation in giga presses and materials will drive large-scale giga casting adoption, enabling ***faster scaling and cost-efficient production*** via ***OEM and Tier 1 partnerships***	Automotive Tier 1 suppliers (Linamar, Guangdong Hongtu Technology, Ryobi, etc.) are transforming the landscape, ***investing heavily*** in giga casting infrastructure to offer OEMs a ***scalable solution*** that balances innovation with ***risk-sharing***, bypassing heavy capital investments.	Seekers (Legacy OEMs) are expected opt for ***outsourcing*** to Tier 1 suppliers, leveraging their advanced capabilities to avoid the capital risk of in-house giga casting while accelerating their ***transition*** to next-gen EV platforms

05 FutureBridge Perspective

Our perspective on the future roadmap – Emerging EV players will lead innovation, but legacy automakers will quickly catch up with Tier 1 suppliers' support, reshaping the manufacturing landscape

1. EV Startups: Leading the way!

Emerging EV players such as Zeekr, and Xpeng, along with Tesla, the market leader, are set to continue spearheading giga casting adoption as their production lines are designed around the giga presses

Start-ups focusing on in-house production
Expect entrance of newer players

Legacy players entering the market

2. Legacy Players: Navigating opportunities

Established players such as Toyota, GM, Volvo, Hyundai, will test giga casting via in-house capabilities for measuring success and collaborate with Tier 1 suppliers for mass production

In-house production as a dip-test to measure success

Collaborate with tier players for large scale production

3. Tier Suppliers: Catalysts for faster adoption

Tier 1 suppliers will start investing in giga casting infrastructure, empowering legacy automakers to scale while minimizing capital expenditures

Testing investment and success with emerging players in PV

Expand to CV and support legacy players in mass production

4. Localization: Regional revolution

China and the US are currently leading in giga casting adoption. With push for sustainability and light weight vehicles, Europe will soon enter the fray

China and US to lead the giga casting economics

European players to follow the lead soon

Localization will push for global adoption

Thank you

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