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CENTER FOR AUTOMOTIVE RESEARCH

Rebuilding North American Tooling

Risk, Resiliency, and a New Economic Model

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Executive Summary

What industry leaders and policy makers must know:

- ***CAR's interviews indicate that North America cannot launch, redesign, or refresh vehicles at scale without Chinese tooling. That dependence makes tooling a strategic chokepoint for automotive production and national security.***
- ***In 2025, Taiwan, Vietnam, and China supplied a combined 88.2 percent share of U.S. cutting tool and accessory imports by unit volume.***[1] ***China alone supplied 43.1 percent of industrial mold units, more than double the share of second ranked Canada.***[2]
- ***North America's tooling economic model***[3] ***is no longer competitive with China's.***
- ***Three decades of decline and deeply rooted structural problems demand a joint industry–government response, according to interviewees.***

The North American automotive industry faces a growing strategic dilemma that in the view of Center for Automotive Research (CAR) demands urgent attention from automakers, auto parts suppliers, and policymakers. Much of the industry's attention has focused on vehicle affordability, tariffs, and underperforming EV investments. By comparison, this issue appears small by $-value, and its economic consequence difficult to measure. Yet it has significant, outsized strategic implications for supply chain resiliency and national security.

The issue is tooling: locally-sourced dies, molds, fixtures, jigs, equipment, and related accessories. North American automotive manufacturing has depended on such tooling for more than a century. Tooling availability determines whether automakers can launch, redesign, and maintain vehicle production. They are typically produced by small, privately-held businesses especially exposed to economic shocks, rising costs, and skilled labor shortages.

A modern vehicle contains roughly 20,000–30,000 parts across 1,800–2,000 major subassemblies, including propulsion, transmission, and suspension systems. All parts and subassemblies require tools to launch a new vehicle, redesign it, and refresh it with minor interior and exterior changes. Without the right tools, automakers cannot launch, produce at scale, or reshore. Succinctly put, tools are foundational for automakers, suppliers, workers, and technologies also needed by defense, aerospace, and North American industry at large.

CAR's interviews indicate that North America cannot launch, redesign, or refresh vehicles at scale without Chinese tooling. That dependence makes tooling a strategic chokepoint for automotive production and national security.

The trade data alone does not tell the whole story. Since the United States imposed Section 301 tariffs on China in 2018[4], China imports have declined, while those from Taiwan, Vietnam, and Thailand have risen sharply. Together, these four markets supplied 74.6 percent of measured U.S. metalworking machinery import units in 2025.[5] Vietnam's share alone climbed from 0.3 percent in 2019 to 25.2 percent in 2025. Study respondents say this rapid growth would not have been achievable without the expansion of Chinese tooling firms and their growing influence across the region. Interviewees report similar expansion by Chinese tooling firms in Mexico, although the available trade data do not yet capture its extent.

In 2025, Taiwan, Vietnam, and China supplied a combined 88.2 percent share of U.S. cutting tool and accessory imports by unit volume.[1] ***China alone supplied 43.1 percent of industrial mold units, more than double the share of second ranked Canada.***[2]

China supplied 43.1 percent of U.S. industrial mold import units in 2025, versus 15.4 percent of import $-value.[6] For machine tools, China's shares were 24.6 percent of units and 4.6 percent of $-value.[7] In cutting tools and accessories, Taiwan, Vietnam, and China together supplied 88.2 percent of measured unit volume.[1] Toolmakers describe this as an unhealthy dependence — arguably an addiction in categories where automakers and suppliers have no readily qualified alternative.

U.S. tool and die-related employment has fallen sharply over three decades, leaving the industry less able to absorb economic shocks and replace retiring workers. Since 1990, private sector employment has risen nearly 49 percent, while U.S. metalworking machinery employment has fallen about 46 percent. Manufacturing employment fell about 29 percent. Special die and tool employment[8] and the combined mold, cutting tool, and other metalworking segments are[9] near the lowest levels in reported history going back over three decades; machine tool manufacturing[7] is the notable exception. Tooling establishments fell 15 percent from 2014 to 2025, and inflation-adjusted output in 2025 remained 33 percent below its 1997 peak. Tool-and-die workers declined 23 percent from 2009 to 2025 while their average age climbed from 49 to 54. In the Midwest, where tooling employment is most concentrated, retirements make replacing this workforce especially urgent.[10]

North America's tooling economic model[3] ***is no longer competitive with China's.***

Study participants describe decades of survival mode and feast-or-famine work. Many tool shops are small, privately-held firms with annual revenue around $5 million[11], and

limited access to affordable capital. They finance steel, engineering, skilled labor, and equipment long before final payment; Chinese suppliers receive most of the payment before shipment and benefit from government subsidies including 1.75% financing or interest free loans[12]. Customer-specific specifications and uncertain program volumes compound the problem. These terms discourage investment while Chinese competitors draw on affordable capital, large engineering teams, advanced equipment, common components, and closely coordinated suppliers.

Three decades of decline and deeply rooted structural problems demand a joint industry–government response, according to interviewees.

Government, automakers, suppliers, and toolmakers must establish an industry-government task force with clear authority to map critical tools and backup capacity, reform payment and sourcing terms, and commit work, capital, and training to regional suppliers. Tool shop owners describe a lost generation of skilled workers and believe rebuilding global competitiveness could take more than a decade. That makes near-term sourcing commitments and globally competitive payment terms essential to support investment while the workforce is rebuilt. According to interviewees, the automotive industry cannot wait a decade to act as rising demand from defense, AI data centers, and utilities competes for skilled workers, equipment, and industrial capacity. The objective is not simply to reshore more tools, but to rebuild the economic model needed to make North American tooling globally competitive.

1. Tooling Has Reached a National Security Chokepoint

Dies, molds, fixtures, gauges, and assembly systems enable manufacturers to produce and assemble parts at scale to precise specifications. CAR estimates that a new vehicle needs more than 2,100 different tools to launch, a major redesign more than 1,600, and even a refresh with minor interior and exterior changes more than 500. Without the necessary tools, a vehicle cannot launch, a plant cannot sustain quality, and an automaker cannot respond quickly to engineering changes.

Automotive production requires tools across a wide range of volumes and costs, from high-volume, lower-cost cutting tools and consumables to low-volume, high-cost machinery such as stamping presses. CAR's analysis captures these categories within NAICS 3335, Metalworking Machinery Manufacturing; all are essential to automotive production.[13]

The importance of tooling extends beyond automotive. Defense and other advanced manufacturing sectors rely on many of the same suppliers, skilled trades, machine tools, materials, and production technologies. Automotive programs provide the scale that sustains investment and skilled jobs across that shared base. Losing automotive

tooling work therefore weakens capabilities and economies of scale available to defense.

The strategic risk is not limited to the disappearance of an entire industry. Losing one specialized diemaker, mold supplier, or repair capability can put a launch or production line at risk. Automakers already depend on Chinese tooling for current programs. If regional shops cannot finance equipment, recruit workers, or meet program timing, that dependence will deepen.

The unhealthy cycle is self-reinforcing: fewer regional orders weaken margins; weak margins limit investment; and limited investment reduces capability and competitiveness. By the time the effect appears as a delayed launch or unavailable replacement tool, the missing supplier or skilled workforce can take years to rebuild.

This is why tooling is both an automotive and national security issue. The region needs enough qualified suppliers to build, maintain, repair, and replace critical tools. A higher quotation on the next program cannot immediately restore a shop that has closed or the knowledge it carried.

Evidence of a narrowing industrial base

Tool shops serve several industries at once, including automotive, defense, aerospace, energy, and pharmaceuticals. CAR uses NAICS 3335, Metalworking Machinery Manufacturing, as a broad measure of this shared industrial base. It includes molds[6]; special dies, jigs, and fixtures[8]; cutting tools and accessories[1]; machine tools[7]; and other metalworking machinery[14]. This classification is an indicator, not a direct measure of available automotive tooling capacity. Detailed definitions appear in the appendix.

Employment has been essentially in free fall for more than three decades. U.S. metalworking machinery employment fell from 271,200 in January 1990 to 147,700 in June 2026, a loss of more than 123,000 jobs, or 46 percent. It reached nearly 290,000 at the end of 1997 before falling to about half that level.

Special die and tool manufacturing[8] shows the same pattern. Employment stood at 110,900 in December 1997. It had fallen to 48,300 by June 2026, or 56 percent. Machine tool manufacturing[7] also contracted, although it recovered from its postrecession low. Employment in that segment fell from 65,300 at the beginning of 1990 to 42,800 in June 2026, down 34 percent.

The losses are not limited to employment. U.S. metalworking machinery establishments declined from 8,668 in the first quarter of 2014 to 7,408 in the fourth quarter of 2025, about 15 percent.[15] Some toolmakers estimate that automotive-focused shops have declined by as much as 70 percent over the past two decades since low-cost-country (LCC) quoting strategies became common practice. This interview estimate is not an industry-wide establishment count. Each closure can remove specialized capacity,

customer knowledge, and skilled labor that cannot be quickly replaced, in the view of study participants.

Real output provides another stark warning. Inflation-adjusted sector output was about 19 percent lower in 2025 than in 1989 and 33 percent below its 1997 peak. While nominal output has increased, much of that growth reflects higher prices rather than increased production. Productivity per worker has improved, but those gains have not been enough to offset declines in employment and establishments, leaving total real output well below historical levels.

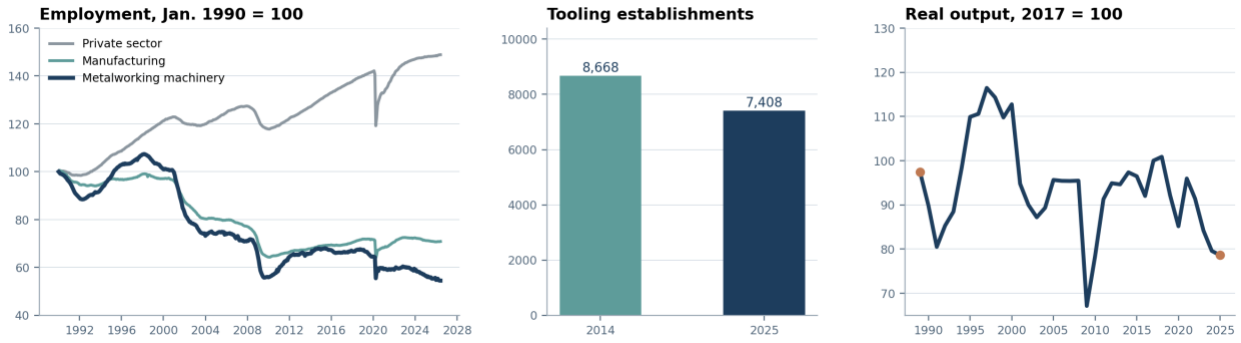
North American shops have become more productive, but employment, establishments, and inflation-adjusted output have still fallen. The Midwest contains the largest share of tool-and-die work, according to CAR's analysis; retaining its experienced workers and training replacements is central to reshoring. Customers also report gaps in large dies, specialized molds, tryout, and repair even when aggregate shop capacity appears available.

Table 1. U.S. metalworking machinery industry indicators

Indicator	Earlier period	Recent period*	Change
Total Employment	271,200 (Jan. 1990)	147,700 (Jun. 2026)	Down 46%
Special die and tool employment[8]	110,900 (Dec. 1997)	48,300 (Jun. 2026)	Down 56%
Machine tool employment[7]	65,300 (Jan. 1990)	42,800 (Jun. 2026)	Down 34%
Establishments	8,668 (Q1 2014)	7,408 (Q4 2025)	Down 15%
Real sector output index	97.4 (1989)	78.6 (2025)	Down 19%

*Source: Preliminary CAR analysis of U.S. Bureau of Labor Statistics data. NAICS 3335. *Most recent data available.*

Figure 1. Contraction of the U.S. tooling industrial base



Source: CAR analysis of U.S. Bureau of Labor Statistics data. Employment series indexed to January 1990; establishments show Q1 2014 and Q4 2025; output is a 2017-based real index.

Why the losses matter

Toolmakers produced more per worker even as the base contracted. CAR estimates real output per worker rose nearly 50 percent from 1990 to 2023. In 2025, however, total real output was about one-third below its late-1990s peak, and special die and tool employment remained near all-time lows. Productivity alone has not has not offset the decline in workers or substituted the specialized capacity needed for substantial reshoring.

Capacity is difficult to measure because tool shops operate as job shops across automotive, aerospace, pharmaceuticals, defense, and other customers. Employment totals do not show whether a large die builder, mold specialist, or tryout team is available when vehicle programs overlap. At CAR's study roundtable, customers said some tooling orders still take about 15 weeks or longer, seemingly unchanged over two decades despite meaningful productivity gains. Toolmakers cited shortages of skilled workers and materials, including P20 tooling-grade steel, as compounding the delay.[16]

The result is a direct constraint on launches and production. If a critical tool or outside process cannot be sourced and validated on schedule, the entire program can slip. Constrained regional capacity and tariff risk make reliance on imported tools more precarious. Regional capacity should be assessed by the tools and services needed to launch, repair, and change production — not simply by jobs or industry output.

2. China's Reach and North America's Tooling Dependence

China's tooling advantage rests on an entire ecosystem: access to capital, engineering scale, advanced equipment, common components, and close coordination among suppliers. Interviewees cite provincial and local support (subsidies) as well. Therefore, lower labor costs alone do not explain how quickly Chinese suppliers can deliver such a wide range of tools at prices below those of North American suppliers. Study participants say North American vehicle programs now rely on this system.

China's emergence in the U.S. market

Study participants trace China's rise in tooling to the growing use of low-cost-country (LCC) sourcing in the early 2000s, as automakers faced increasing cost pressures. CAR measures this trade at the metalworking machinery industry level, which combines several tooling and equipment sub-sectors. U.S. imports from China in this broader industry rose from $39 million in 1989 to about $1.2 billion in 2025, after peaking near $2.1 billion in 2018. China accounted for nearly 8 percent of import $-value in 2025.[17] That dollar share captures only part of its role: China supplies a much larger share of import units in several tooling categories. Table 2 traces directly reported imports from

China across four sub-sectors within metalworking machinery. The industry total also includes rolling mill and other metalworking machinery, which is not shown in Table 2. Table 3 compares China's 2025 rankings by $-value and unit volume across all five sub-sectors.[20]

Table 2. Growth of reported U.S. imports from China

Industry category	1997 $-value / % share	2019 $-value / % share	2019 units / % share	2025 $-value / % share	2025 units / % share
Industrial molds[6]	$8M / 0.6%	$526M / 21.5%	10,014,849 / 37.1%	$347M / 15.4%	13,970,238 / 43.1%
Special dies and tools[8]	$1M / 0.2%	$127M / 15.1%	2,651,222 / 41.0%	$88M / 10.1%	964,946 / 19.0%
Cutting tools and accessories[1]	$28M / 3.2%	$401M / 14.0%	285,446,831 / 54.1%	$342M / 8.8%	91,549,511 / 13.6%
Machine tools[7]	$66M / 1.2%	$523M / 6.6%	150,399,159 / 36.7%	$340M / 4.6%	82,104,040 / 24.6%

Source: Preliminary CAR analysis of U.S. International Trade Commission DataWeb data. $-values rounded.[18,19]

In CAR's view, unit volume reveals dependence on lower-priced tools that import $-value alone does not fully capture. In 2025, China ranked first for industrial molds by units (43.1 percent), but second by $-value (15.4 percent). It ranked first for machine tools by units (24.6 percent), but seventh by $-value (4.6 percent). For cutting tools and accessories, China ranked third by units (13.6 percent), behind Taiwan (39.1 percent) and Vietnam (35.5 percent).[20] Units do not measure equal production importance across tools, but they show how widely these lower-priced products enter U.S. supply chains.[20]

***Table 3.* China's 2025 rank among U.S. tooling import sources by $-value and unit volume[20]**

U.S. industry category	China $-value rank	China $-value share	China unit-volume rank	China unit-volume share
Industrial molds[6]	2nd	15.4%	1st	43.1%
Special dies, tools, die sets, jigs, fixtures[8]	4th	10.1%	2nd	19.0%
Cutting tools and machine tool accessories[1]	4th	8.8%	3rd	13.6%
Machine tools[7]	7th	4.6%	1st	24.6%
Rolling mill and other metalworking machinery[14]	3rd	6.9%	5th*	6.1%

Source: CAR analysis of U.S. International Trade Commission DataWeb data, 2025. Unit shares cover only HTS codes reporting quantities by number; weight-reported imports are excluded. Product mix and unit prices differ across sources.

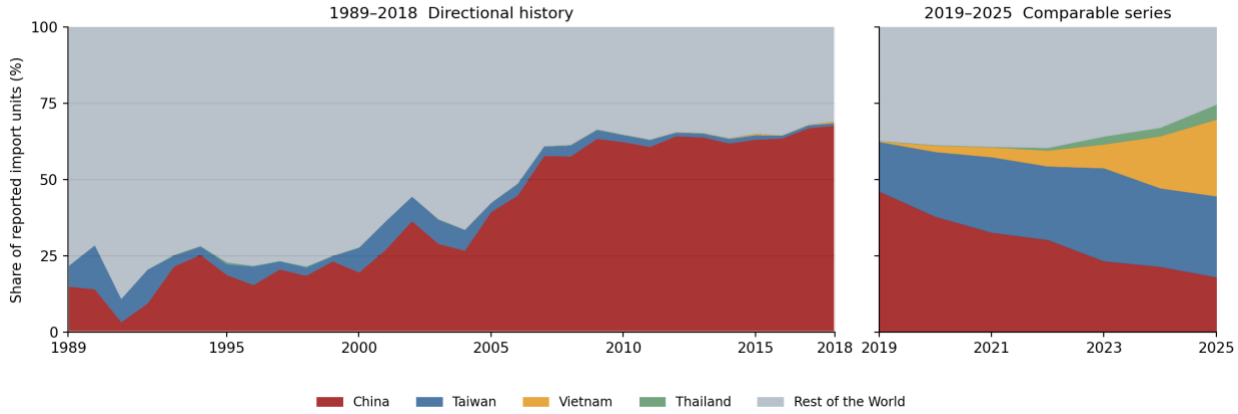
**The rolling mill and other metalworking machinery unit data have reporting discrepancies that limit ranking comparisons over time.*

These tools may carry a smaller price tag but remain essential to production. Interviewees also report that tools can be bundled with equipment, recorded under other customs classifications, or routed through intermediate countries. These practices further limit what direct China import $-values reveal about automaker and supplier dependence. More complete import disclosures are needed to trace tools that enter under other classifications or through intermediate countries.

China's expanding sphere of influence

The Section 301 tariffs imposed on China beginning in 2018 altered the trade pattern. Direct imports from China fell, while imports from Taiwan, Vietnam, and Thailand rose substantially.[4] In 2025, these four countries supplied 74.6 percent of measured U.S. metalworking machinery import units: Taiwan 26.5 percent, Vietnam 25.2 percent, China 18.1 percent, and Thailand 4.9 percent. Figure 2 shows how sourcing became more concentrated across this group of markets. A 2019 HTS classification change limits direct comparison with earlier unit data.[21]

Figure 2. Southeast Asia share of U.S. metalworking machinery import unit volume, 1989–2025



Source: CAR analysis of USITC DataWeb. Only HTS lines measured by number are included; weight-measured lines are excluded. Data before 2019 are directional because classification and reporting changes limit direct comparison with the 2019–2025 series. The country grouping measures reported sourcing, not ownership. Country shares are rounded individually and may not sum to the reported aggregate.[22]

Interviewees report that Chinese tooling firms expanded their influence in Taiwan, Vietnam, and Thailand following the imposition of Section 301 tariffs. Vietnam's share of measured U.S. metalworking machinery import units rose from 0.3 percent in 2019 to 25.2 percent in 2025. Study participants say growth on that scale would be unlikely without the involvement of Chinese companies. These accounts indicate that lower direct imports from China do not necessarily reduce automaker and supplier dependence on Chinese tooling. Interviewees report more recent expansion into Mexico as well, but reporting lags mean that this activity is not yet reflected in the available trade data. Customs data record reported trade origins; they cannot establish the ownership or engineering and production origin of individual tools. The extent of

Chinese activity in these markets requires further investigation. The category breakdown appears in Table A1 in the appendix.[30]

Cutting tools and accessories may provide an early warning for other tooling categories. Taiwan, Vietnam, and China supplied 88.2 percent of measured U.S. import units in this category in 2025; including Thailand brings the four-country share to 88.7 percent (Table A1). This concentration shows the magnitude of automaker and supplier dependence on imported tools and, alongside interview accounts, points to China's growing influence across these markets. Diversifying among countries within the group may leave customers exposed to shared regional disruptions.

Capital, scale, pricing, and excess capacity

Interviewees say access to low-cost capital and government support allows Chinese toolmakers to invest in equipment and larger engineering teams. They cite provincial and local support (subsidies), including loans at 1.75 percent or zero interest. They report bids at roughly one-third of North American prices for some small dies made with Chinese components and 25–30 percent below North American prices for large dies. In some cases, bids reportedly fall below North American material costs. These are interview examples, not verified market-wide terms.

CAR estimates that China had approximately 15 million vehicles of excess annual production capacity in 2025, with capacity utilization of 68 percent.[23] This makes it reasonable to consider whether Chinese tool-and-die shops also have excess capacity, but vehicle capacity does not establish tooling utilization. Reliable estimates of Chinese tooling capacity and comparable shop-level benchmarks remain difficult to obtain.

In his MBS 2026 presentation, Martinrea CEO Pat D'Eramo highlighted the disparity in die-shop scale between China and North America. He cited more than 100 Chinese tool-and-die shops, each with over 750,000 square feet, 1,000 engineers, and annual capacity to produce 800 medium and large dies. By comparison, he cited fewer than five North American die shops with more than 300 employees and annual capacity of 150 dies per shop. These figures illustrate the reported difference in scale and production capacity; they have not been independently verified by CAR.[24]

Technology and integrated supply chain

Chinese suppliers use modern machine tools, automation, software, and digital manufacturing systems. These can reduce labor content and shorten engineering, machining, and tryout cycles. North American shops also use advanced technology; the difference identified in interviews includes access to capital and the ability to deploy it at scale.

The surrounding supply chain matters. Ready access to P20 tooling-grade steel, castings, components, heat treatment, machining, and engineering support lets shops

coordinate work and meet launch deadlines. North America needs similar integration across its regional supplier base to improve pricing, delivery times, as well as overall supply chain efficiency.

Commercial complexity

Chinese automakers use common components and standards to reduce repeated engineering work and shorten development cycles. The China Automotive Standardization Research Institute (CASRI), within CATARC, supports the development, coordination, and application of national automotive standards, including work on intelligent chassis and chassis-by-wire systems. As part requirements become more consistent, the tools and processes used to produce them can also become more repeatable. This provides a basis for common tooling requirements within standardized component areas, although it does not mean that all Chinese automakers use identical tools.[25]

Declining direct imports from China do not, by themselves, demonstrate reduced automaker and supplier dependence. Sourcing from additional low-cost countries can spread immediate risk, but it does not rebuild North American tooling production, repair, and replacement capacity.[26]

3. North America's Tooling Economic Model Is No Longer Competitive

North America's tooling economic model describes how customers specify, source, finance, build, pay for, and maintain tools. CAR's interviews indicate that the current terms are no longer competitive with China's – putting North American tooling firms at a decisive competitive disadvantage. Tool shops need to invest before orders are certain, yet face long payment cycles, changing customer design specifications, and limited access to affordable capital. The problem is pervasive, structural and shared across all industry stakeholders including automakers, suppliers and toolmakers.

Legacy, uncompetitive payment terms

Payment terms vary widely by customer. Some shops receive competitive progress payments tied to work completed; all report that payment can be deferred though until PPAP, or for 90–120 days afterward. These terms often reflect the relative bargaining power of large automakers and suppliers (customers) versus smaller tool shops, rather than the timing of material and labor costs. Toolmakers must then finance steel, engineering, machining, and tryout while waiting for payment. Interviewees contrast this with some Chinese suppliers receiving up to 90 percent at shipment, before PPAP, with a 10 percent holdback until vehicle launch.[31]

Small and mid-sized tool shops often struggle to finance equipment and working capital. Interviewees describe many as small, privately-held entrepreneurial firms; CAR estimates average annual revenue at roughly $5 million. Extended payment terms, specialized equipment and inventory, and customer concentration lead lenders to view many tool-and-die shops as higher risk, resulting in a higher cost of capital at best and unavailable credit at worst.[11]

These legacy terms are antiquated and uncompetitive with those available in low-cost regions. At best, financing costs are passed back to customers through higher tool prices. At worst, delayed payment during a downturn can push a shop toward insolvency. Automaker EV program cancellations and asset write-downs have added to the pressure: some toolmakers report that they have not been fully compensated for canceled work. Consistent progress payments and clear cancellation terms would reduce these costs and risks.

Commercial practices

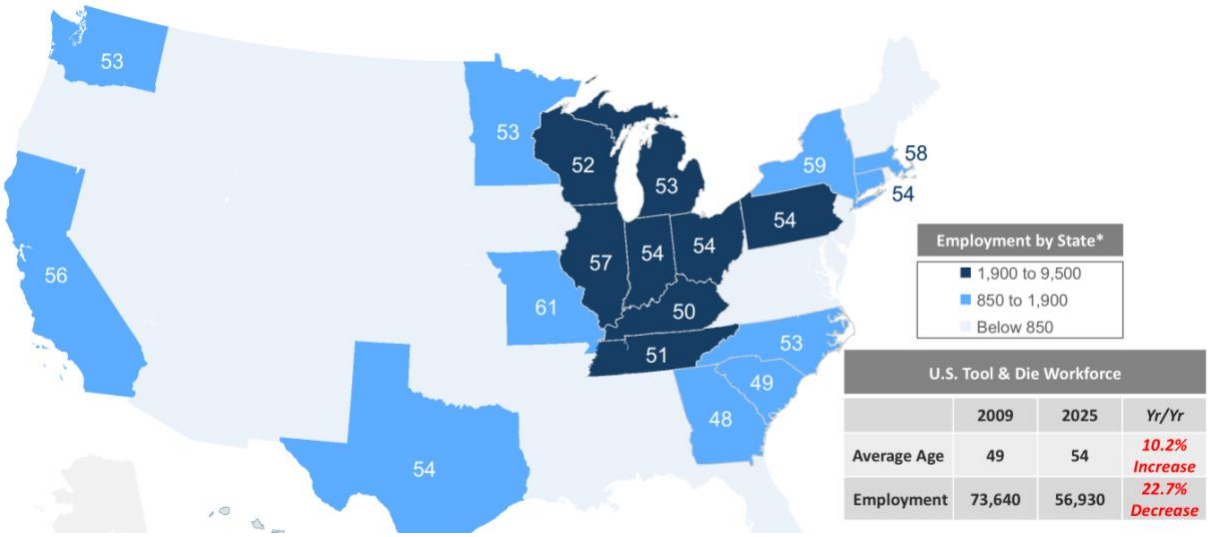
Tool sourcing decisions remain heavily determined by the lowest initial quoted price. Yet low-cost-country (LCC) sourcing, including China, is not necessarily lowest-cost over a tool's full lifecycle. Interviewees say initial bids often exclude tariffs, freight, LCC program management, engineering changes, launch support, maintenance, repair, downtime, and replacement tools. Many customers still rely on legacy costing templates that do not consistently capture these costs.[32]

When sourcing rewards the lowest initial quote and shifts financing risk to suppliers, shops have less ability to invest in automation, training, and capacity. These commercial terms affect the price and capability customers will see on subsequent tools supplied as well.

Workforce and operating constraints

The skilled trades workforce is aging, and qualified workers are in short supply. CAR analysis finds that U.S. tool-and-diemaker employment fell 22.7 percent, from 73,640 in 2009 to 56,930 in 2025, while average age rose from 49 to 54. Toolmakers, machinists, designers, programmers, and process engineers require years of training and experience. Volatile demand and thin margins reduce employers' ability to recruit, train, and retain replacements. Tool-and-die employment is concentrated in the Midwest, particularly Michigan, Ohio, Illinois, Indiana, and Wisconsin, with Pennsylvania, Kentucky, and Tennessee also among the highest-employment states.

Figure 3. U.S. tool-and-die employment concentration and average age by state



Source: CAR analysis; U.S. Bureau of Labor Statistics. Employment: May 2025; state average ages: 2024. Numbers on the map indicate average worker age.[27]

Tool shops rely on nearby suppliers for tooling-grade steel, castings, heat treatment, controls, machining, and engineering support. Interviewees report that access to P20 tooling-grade steel at globally competitive prices is a particular concern; shortages or high input costs anywhere in this chain can delay delivery and weaken North American bids. Rising demand from defense, data centers, and power utilities is also competing for workers and certain industrial processes, adding pressure when automotive launch schedules overlap.

The current economic model deepens dependency

Delayed payments and uncertain demand make it difficult for North American tool shops to finance current work, invest in new capacity, or expand their workforce. Accelerated depreciation via tax incentive programs can reduce equipment costs, but it cannot resolve how customers buy and pay for tools.

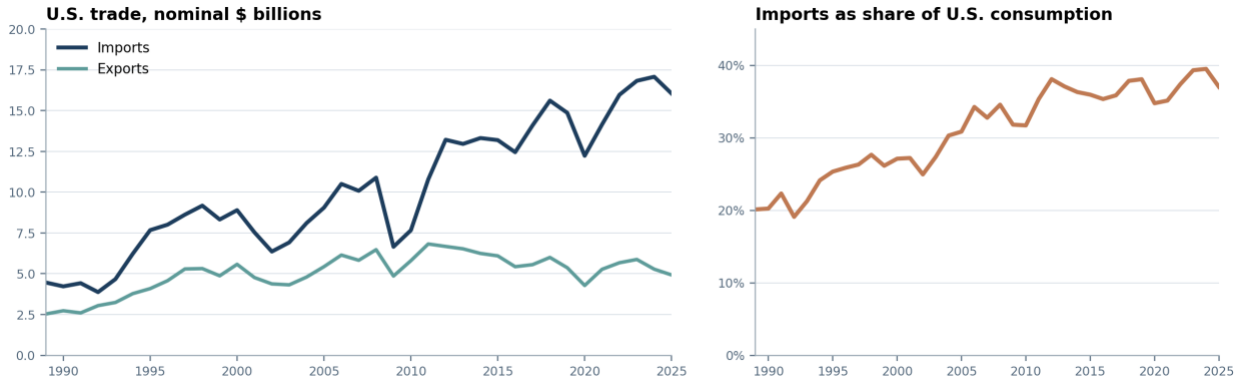
The scale of import dependence shows why those terms matter. U.S. metalworking machinery imports rose from $4.5 billion in 1989 to $16.0 billion in 2025, while exports rose from $2.5 billion to $4.9 billion. The nominal trade deficit widened from about $1.9 billion to $11.1 billion. Imports accounted for 37 percent of U.S. domestic consumption in 2025, up from about 20 percent in 1989.[28]

Table 4. U.S. metalworking machinery trade and domestic consumption

Measure	1989	2025	Change
Imports	$4.5 billion	$16.0 billion	Up 260%
Domestic exports	$2.5 billion	$4.9 billion	Up 94%
Trade balance	-$1.9 billion	-$11.1 billion	Deficit widened $9.2B
Domestic consumption	$22.2 billion	$43.3 billion	Up 95%
Import share of consumption	20.1%	37.0%	Up 16.9 points

Source: Preliminary CAR analysis of U.S. International Trade Commission DataWeb data. SIC used through 1996 and NAICS thereafter. $-values are nominal except the separately reported real output index.

Figure 4. Rising U.S. import dependency



Source: CAR analysis of USITC DataWeb. Trade $-values are nominal. Domestic consumption equals shipments plus imports less exports; the import share uses nominal $-value. SIC classifications are used before 1997 and NAICS thereafter.

4. Rebuilding North American Tooling Competitiveness

CAR's interviews with automakers, suppliers, tool-and-die shops, trade associations, and industry consultants point to the same conclusion: North America's tooling challenge is structural, not cyclical. The issues raised repeatedly were extended (uncompetitive) payment terms, limited access to affordable capital, customer-specific requirements (lack of standardization), workforce shortages, uneven technology investment, fragmented tooling information, and sourcing practices that overemphasize (reward) the lowest initial quotation. These are not isolated complaints from one segment of the value chain. They are the conditions industry participants said have accumulated over three decades and now constrain reshoring and future competitiveness.

The response must therefore go beyond greater collaboration among existing stakeholders. Collaboration is necessary, but three decades of decline and inattention have left strategic gaps in capacity, workforce, financing, technology, and supplier infrastructure that individual companies cannot close on their own. Rebuilding

competitiveness requires coordinated action by automakers, suppliers, toolmakers, financial institutions, the United States and Canada, and government agencies with a direct interest in industrial capacity and national security.

Canada must remain part of this strategy, according to CAR interview findings. Canadian tool-and-die, mold, engineering, and supplier capacity has been historically significant to North American automotive production, and vehicle programs routinely draw on integrated capacity on both sides of the U.S.-Canada border. Policies that add friction to cross-border movements of tools, materials, technical personnel, or capital risk weakening the regional ecosystem that reshoring is intended to strengthen.

CAR research findings: the North American economic tooling model must change

Interviewees consistently described the tooling economic model itself as a barrier to investment. Toolmakers finance steel, engineering, machining, skilled labor, tryout, and equipment well before final payment, while customers can change designs, timing, specifications, and program volumes during the build. Smaller shops then carry working-capital risk that is difficult or expensive to finance. The result is predictable: cash that could fund automation, workforce development, or new capacity is instead tied up financing customer programs.

Study participants repeatedly identified progressive payments as one of the most immediate issues to address. A joint industry-government task force should benchmark payment structures already used by the U.S. Department of Defense, including progressive payments tied to verified work and material commitments, and determine how comparable principles could be applied to automotive tooling. The objective is not to copy defense contracting rules wholesale. It is to establish globally competitive commercial terms that recognize the capital intensity and long lead times inherent in tooling.

Interviewees also called for sourcing decisions to account for total lifecycle value rather than the initial quotation alone. Tariffs, freight, program management, travel, engineering changes, launch support, maintenance, repair, downtime, replacement tools, and supply risk can materially change the economics after sourcing. At the same time, CAR is not advocating that automakers and suppliers eliminate low-cost-country sourcing. Global sourcing will remain part of a competitive automotive industry. The priority is to identify where North American capability is strategically necessary and jointly improve the economics, productivity, and reliability of the regional tooling ecosystem so that qualified North American suppliers can compete for that work.

CAR'S INTERVIEW FINDINGS: A CALL TO ACTION FOR INDUSTRY

- Benchmark and adopt globally competitive progressive-payment and cancellation terms tied to verified tooling milestones.

- Evaluate sourcing on total lifecycle value and supply risk, not the initial quotation alone.
- Offer qualified North American suppliers long-term purchase commitments in exchange for greater visibility and accountability, enabling investment in capacity, technology, and workforce.
- Commonize specifications, quoting requirements, acceptance rules, and tooling information everywhere is technically feasible.
- Identify launch-critical tools, repair capabilities, backup capacity, and supplier dependencies across Southeast Asia and other global sourcing regions, and map qualified alternative sources in the United States and Canada.

Capital, Technology, and Workforce Must Be Addressed Together

Interviewees did not describe capital, technology, and workforce as separate problems. They reinforce one another. Limited access to affordable capital delays equipment purchases; older equipment can reduce productivity and increase labor requirements; thin and volatile margins make training harder to sustain; and workforce shortages limit the return on new equipment when shops cannot recruit designers, programmers, machinists, toolmakers, and process engineers. Rebuilding one part of the system without the others will not restore global competitiveness.

Technology investment is especially important as demand grows outside automotive. Defense spending, AI data centers, power generation, utilities, aerospace, and other advanced manufacturing sectors are competing for many of the same skilled workers, machine tools, materials, engineering capabilities, and industrial processes. Automotive provides the production scale that has historically sustained much of the North American tooling base, but defense and other strategic sectors increasingly depend on that same base. This makes tooling capacity and modernization a national security issue as well as an automotive competitiveness issue.

Government participation is therefore required. Public policy should treat tooling as strategic manufacturing infrastructure and focus on verified capability gaps, affordable equipment and working-capital financing, workforce development, and access to advanced technology. Tax incentives and accelerated depreciation can help, but interviewees made clear that tax treatment alone does not fix extended payment terms, uncertain demand, or limited credit access. Public tools must be paired with customer commitments and a commercial model that supports continuous reinvestment.

CAR'S INTERVIEW FINDINGS: A CALL TO ACTION FOR GOVERNMENT

- Treat tooling capacity as strategic manufacturing infrastructure in automotive, industrial, and national security planning.

- Establish an industry-government tooling task force with the authority and representation needed to drive action, including automakers, suppliers, toolmakers, financial institutions, trade associations, and relevant government agencies.
- Benchmark Department of Defense progressive-payment practices and identify commercially adjacent applications for automotive tooling.
- Expand access to affordable equipment and working-capital financing for verified capability and technology gaps, e.g., Defense Production Act Title III, DOE Advanced Technology Vehicles Manufacturing (ATVM) Loan Program, State Small Business Credit Initiative (SSBCI).
- Support apprenticeships, technical education, applied research, and access to advanced manufacturing technology.
- Protect efficient cross-border movement of tooling, materials, technical personnel, and services within the integrated U.S.-Canada tooling ecosystem.
- Improve customs data and enforcement so tooling imports reflect full $-value, origin, classification, and route into North America.

Digitalization Must Support a New Economic Model

Interviewees also pointed to fragmented information as a recurring source of cost and risk. Automakers and suppliers use different design specifications, quoting forms, acceptance requirements, and records. Tool ownership, location, condition, maintenance history, engineering changes, and backup plans are not always consistently visible across the lifecycle. These gaps increase repeated engineering work, complicate sourcing and maintenance, and make tooling assets more difficult for lenders and insurers to evaluate.

A more competitive economic model should use digital records to connect the full tooling lifecycle, from customer engineering design and specifications through quoting, procurement, financing, build, validation, payment, engineering changes, maintenance, repair, and end-of-life. Standardized digital records and interoperable systems can reduce administrative friction, preserve knowledge, improve asset visibility, and provide a stronger basis for lifecycle costing, financing, insurance, and capacity planning. Digitalization is therefore not a stand-alone technology initiative; it is part of redesigning how tooling work is specified, purchased, financed, managed, and paid for.

The same principle applies to emerging manufacturing processes. Mega-casting, advanced automation, AI-enabled engineering, and other technologies require more than a machine purchase. Competitive capability also requires design expertise, materials, simulation, machining, controls, maintenance, repair, process development, and trained workers. North America needs an ecosystem capable of deploying these technologies at scale, not isolated equipment investments.

A Joint Task Force and the Next Phase of CAR Research

The issues identified in this study are larger than any one automaker, supplier, tool shop, trade association, or government program can resolve. After three decades of decline and limited attention, the industry needs a formal task force with clear responsibility, deadlines, and measurable objectives. Its first priorities should be to map launch-critical tooling and backup capacity, identify capability and workforce gaps, benchmark globally competitive commercial and payment terms, and establish where public and private investment can produce the greatest improvement in regional competitiveness.

The task force should also distinguish between tooling that can continue to be sourced globally and capabilities that North America must be able to design, build, repair, modify, or replace regionally. The objective is not autarky, and it is not the elimination of low-cost-country sourcing. It is to reduce strategic dependence, restore competitive regional capacity, and ensure that North American vehicle programs and national-security requirements are not constrained by the loss of critical tooling capabilities.

CAR's next paper will examine the tooling economic model in greater detail with key industry and government stakeholders. That work will follow the complete lifecycle of a tool, including customer engineering design, specifications, quoting, procurement, sourcing, financing, payment, manufacturing processes, validation, digital records, engineering design changes, maintenance, repair, and replacement. The goal is not incremental improvement to the existing model. It is to identify how the economic model must be redesigned so the North American tooling industry can be globally competitive in the future and support sustained reshoring.

Conclusion

Tooling is a national security issue because automotive and defense draw on the same industrial base. A new vehicle requires more than 2,100 different tools to launch; a major redesign needs more than 1,600. Even a refreshed model needs more than 500. Without the right dies, molds, fixtures, and replacement tools, production cannot begin or continue at scale.

CAR's interviews indicate that North America cannot support current vehicle programs at scale without Chinese tooling. The direct China import figures tell only part of the story: China ranks first by measured U.S. units for molds and machine tools, and imports from Taiwan, Vietnam, and Thailand grew substantially in many cases after Section 301 tariffs were imposed on China. These country shifts do not prove that every shipment is Chinese-owned, but they make direct bilateral $-value significantly understate exposure and dependency.20

The situation is getting worse, not better. Employment, establishments, and real output have declined even as shops improved productivity. Toolmakers describe feast-or-famine work, delayed payments, customer-specific requirements, and limited access to affordable capital. North America's tooling economic model is no longer competitive with China's. Another vehicle launch cycle under the same terms will deepen the dependence without action by automakers, suppliers and policymakers.

Automakers and suppliers should identify the tools and processes whose loss could stop each program, then document ownership, location, repair, and backup plans. They should improve payment and sourcing terms to support investment, standardize requirements where feasible, and commit work to qualified regional suppliers. Government should help finance the shared equipment and workforce the industry needs.

A joint industry–government task force should set deadlines, assign responsibility, and measure the capabilities restored, according to study participants. Rebuilding will take a decade or more following three decades of decline and inattention. The work must begin now.

Appendix: Definitions and Key Tooling Terms

Domestic consumption. Domestic industry output plus imports for consumption minus domestic exports, used here to calculate domestic reliance on imports by nominal $-value.

HTS. Harmonized Tariff Schedule, the U.S. 10-digit product classification used to determine import duty rates and regulatory requirements.

Import unit share. The share of reported imports counted by number of units under the applicable HTS lines; lines measured by weight are excluded. Unit counts do not equate products of different sizes or complexity.

Metalworking machinery (NAICS 3335). The broad U.S. industry measure used for employment, establishments, and output representative of tooling here. It includes special dies, molds, cutting tools, machine tools, and other metalworking machinery; it is not a count of automotive-only shops.

Six-digit industries within NAICS 3335. The five industries used in this report are described below:

> **333511** — Industrial Mold Manufacturing. Establishments making molds used to cast metals or form materials such as plastics and rubber.
>
> **333514** — Special Die and Tool, Die Set, Jig, and Fixture Manufacturing. Tool and die shops making dies, die sets, jigs, fixtures, and related special tools.
>
> **333515** — Cutting Tool and Machine Tool Accessory Manufacturing. Establishments making cutting tools, accessories, and attachments for metal-cutting and metal-forming machine tools, including drill bits, taps, and dies.
>
> **333517** — Machine Tool Manufacturing. Establishments making metal-cutting and metal-forming machine tools, including machining and stamping equipment.
>
> **333519** — Rolling Mill and Other Metalworking Machinery Manufacturing. Establishments making rolling mill machinery and other metalworking equipment, including some assembly and wire-working machinery.

Historical SIC-to-NAICS mapping. The comparable 1987 SIC activities map into NAICS 3335 as follows; codes shown under 2002/2007 and 2017/2022 are the classifications used in those NAICS vintages:

> **SIC 3544** (special dies, tools, jigs, fixtures, and industrial molds) → 2002: 333511 and 333514; 2007: 333511 and 333514; 2017: 333511 and 333514; 2022: 333511 and 333514. The SIC industry is split between molds and other dies and tools.

SIC 3545 (cutting tools and machine tool accessories) → 2002: 333515; 2007: 333515; 2017: 333515; 2022: 333515. Its precision measuring devices portion maps outside NAICS 3335.

SIC 3541 and 3542 (metal-cutting and metal-forming machine tools) → 2002: 333512 and 333513; 2007: 333512 and 333513; 2017: 333517; 2022: 333517.

SIC 3547 and 3549 (rolling mill and other metalworking machinery) → 2002: 333516 and 333518; 2007: 333516 and 333518; 2017: 333519; 2022: 333519.

Classification note: These are activity correspondences, not a one-to-one conversion of historical values. SIC 3543 industrial patterns and parts of SIC 3545 fall outside NAICS 3335. The machine-tool and other-machinery pairs were consolidated in the 2012 revision and remain consolidated in 2017 and 2022.

Sources: U.S. Census Bureau, 2002 NAICS–1987 SIC concordance; 2007–2002 and 2012–2007 NAICS concordances; 2022 NAICS Manual. Census concordances: https://www.census.gov/naics/concordances/concordances.html

Low-cost country (LCC). A sourcing market used primarily to reduce initial tooling cost relative to North American production. In this report, LCC sourcing includes China and other lower-cost production markets referenced by study participants.

Section 301 tariffs. Additional U.S. duties imposed beginning in 2018 on covered imports from China under Section 301 of the Trade Act of 1974. See note 4.

New vehicle, redesign, and refresh. A new vehicle launches a new program; a redesign changes major systems or body architecture; a refresh makes minor changes to the fascia and to interior or exterior appearance. Each requires new or changed tools.

P20 steel. A pre-hardened tooling-grade steel commonly used in molds and tooling components.

PPAP. Production Part Approval Process, the customer validation process used to confirm that production parts and the process meet requirements.

Tooling. Dies, molds, cutting tools, fixtures, jigs, gauges, and related equipment used to make, hold, measure, or assemble parts.

Reported tooling imports by source

Table A 1. Reported U.S. tooling imports from China, Taiwan, Thailand, and Vietnam[29]

Industry category	2019 units	2019 % share	2025 units	2025 % share
Industrial molds[6]	10,827,215	40.1%	15,544,402	47.9%
Special dies and tools[8]	3,039,850	47.0%	2,170,735	42.7%
Cutting tools and accessories[1]	429,415,906	81.4%	596,120,897	88.7%
Machine tools[7]	166,528,836	40.6%	165,877,393	49.6%
Rolling mill and other machinery[14]	33,972	29.1%	55,011	9.4%
All five categories	609,845,779	62.8%	779,768,438	74.6%

Source: Preliminary CAR analysis of U.S. International Trade Commission DataWeb data. Country grouping measures reported sourcing, not ownership. Unit shares cover only HTS lines reported by units. The four-country cutting tool and accessory share is 88.7 percent; the share excluding Thailand is 88.2 percent.

Figure A 1. Top ten countries ranked by share of U.S. tooling import dollar value, 2025

Rank (#)	Industrial molds NAICS 333511	Special dies, tools, jigs and fixtures NAICS 333514	Cutting tools and accessories NAICS 333515	Machine tools NAICS 333517	Rolling mill and other machinery NAICS 333519
1	Canada	Japan	Germany	Japan	Germany
2	**China**	Canada	Japan	Germany	Italy
3	Germany	Germany	Taiwan	Italy	**China**
4	Japan	**China**	**China**	South Korea	Japan
5	South Korea	South Korea	Israel	Canada	Canada
6	Italy	Spain	South Korea	Taiwan	South Korea
7	Netherlands	Taiwan	Sweden	**China**	Thailand
8	Mexico	Poland	Vietnam	Switzerland	India
9	Austria	United Kingdom	India	Austria	Austria
10	Thailand	Turkey	Canada	Spain	Brazil

Source: CAR analysis of U.S. International Trade Commission DataWeb data.

Figure A 2. Top ten countries ranked by share of U.S. tooling import unit volume, 2025

Rank (#)	Industrial molds NAICS 333511	Special dies, tools, jigs and fixtures NAICS 333514	Cutting tools and accessories NAICS 333515	Machine tools NAICS 333517
1	**China**	Japan	Taiwan	**China**
2	Canada	**China**	Vietnam	Thailand
3	Japan	Germany	**China**	Japan
4	Mexico	Taiwan	Germany	Germany
5	South Korea	Mexico	Japan	Vietnam
6	Spain	South Korea	Italy	Canada
7	Taiwan	Vietnam	Mexico	South Korea
8	Italy	India	South Korea	Taiwan
9	Germany	Canada	India	Italy
10	Thailand	Thailand	Canada	Mexico

** NAICS 333519: Ranking (by unit volume) excluded because CAR identified reporting discrepancies make comparisons difficult. China's share is significant, but its final rank is unknown.*

Source: CAR analysis of U.S. International Trade Commission DataWeb data.

About the Organizations

Center for Automotive Research (CAR)

The Center for Automotive Research (CAR) is an independent, nonprofit research organization that produces industry-driven research and analysis, informs industry leaders and policymakers, and convenes dialogue on critical issues shaping the automotive industry and its competitiveness. www.cargroup.org

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Notes and References

Data note: CAR analyzed U.S. Bureau of Labor Statistics, U.S. Census trade data, and USITC DataWeb data. The broad industry measure is NAICS 3335. Historical trade data use SIC before 1997 and NAICS thereafter. Unit shares include only HTS lines reporting quantity by number; weight-measured lines are excluded. A 2019 HTS classification change limits comparisons with earlier unit data. The country grouping does not establish Chinese ownership. Findings on investment and program dependence reflect confidential interviews completed YTD-September 2026 with automakers, auto suppliers, tool shops, trade associations and industry consultants.

[30] Findings on Chinese tooling-firm expansion in Taiwan, Vietnam, Thailand, and Mexico reflect confidential CAR interviews completed YTD-September 2026 with automakers, auto suppliers, tool shops, trade associations, and industry consultants. Customs data establish reported origin, not ownership.

[31] PPAP means Production Part Approval Process. See Appendix: Definitions and Key Tooling Terms.

[32] Low-cost country (LCC) is defined in Appendix: Definitions and Key Tooling Terms. Lifecycle-cost findings reflect confidential CAR interviews and the September 21, 2026 tooling study roundtable.

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[1] NAICS 333515 — Cutting Tool and Machine Tool Accessory Manufacturing.

[2] NAICS 333511 — Industrial Mold Manufacturing. China 43.1% 2025 share by unit volume, compared to 18.4% Canada (second ranked), 9.3% Japan (third ranked), 5.5% Mexico (fourth ranked), 5.2% South Korea (fifth ranked). See Appendix Figure A2 for the top 10 country ranking by unit volume.

[3] The tooling economic model describes how customers specify, source, finance, build, pay for, and maintain tools.

[4] USTR, Federal Register, 83 FR 47974 (September 21, 2018), Annex A; and 84 FR 20459 (May 9, 2019). Section 301 List 3 imposed an additional 10 percent duty on covered Chinese imports beginning September 24, 2018, increased to 25 percent effective May 10, 2019, subject to transitional provisions for goods already in transit.

[5] USITC DataWeb import-unit series for metalworking machinery industry. Metalworking machinery comprises NAICS 333511, 333514, 333515, 333517, and 333519. Unit shares include only HTS lines reported by number.

[6] NAICS 333511 — Industrial Mold Manufacturing.

[7] NAICS 333517 — Machine Tool Manufacturing.

[8] NAICS 333514 — Special Die and Tool, Die Set, Jig, and Fixture Manufacturing.

[9] Combined employment in NAICS 333511 (industrial molds), 333515 (cutting tools and accessories), and 333519 (rolling mill and other metalworking machinery).

[10] The longer-term decline excludes the partial employment recovery in 2011–2014 following the 2008–2009 recession and GM and Chrysler bankruptcies.

[11] Average shop revenue estimate: CAR analysis of U.S. Bureau of Labor Statistics and Census Bureau data (2024).

[12] *Interviewees described Chinese terms as up to 90 percent paid by time of shipment, i.e., before PPAP, with a 10 percent profit holdback at vehicle launch; terms vary by supplier and program.*

[13] *Cutting tools and consumables: NAICS 333515 — Cutting Tool and Machine Tool Accessory Manufacturing. Stamping presses: NAICS 333517 — Machine Tool Manufacturing. Both are included in NAICS 3335.*

[14] *NAICS 333519 — Rolling Mill and Other Metalworking Machinery Manufacturing.*

[15] *U.S. Bureau of Labor Statistics establishment series for metalworking machinery. Metalworking machinery comprises NAICS 333511, 333514, 333515, 333517, and 333519.*

[16] *CAR tooling study roundtable held September 21, 2026, with automakers, suppliers, industry experts, and tool shops.*

[17] *USITC DataWeb import series for metalworking machinery. The five six-digit NAICS industries within metalworking machinery are 333511, 333514, 333515, 333517, and 333519.*

[18] *Unit volumes and shares are not reported for 1997 because inconsistent reporting requirements left the data incomplete. Reporting conventions changed in 2019, limiting comparisons with earlier years to directional trends.*

[19] *CAR analysis of U.S. International Trade Commission DataWeb data. The analysis includes only HTS lines reporting quantities by number; weight-reported imports are excluded. Unit shares use those reported quantities.*

[20] *Industry categories: industrial molds, NAICS 333511; machine tools, NAICS 333517; cutting tools and machine tool accessories, NAICS 333515. Unit shares include only HTS lines measured by number. See Appendix Figures A1 and A2 for the top ten countries ranked by share of U.S. import dollar value and unit volume, respectively (CAR analysis of USITC DataWeb data, 2025; source presentation, slides 43–44). Figure A2 retains the source caveat: reporting discrepancies in NAICS 333519 prevent a definitive unit-volume ranking for that category.*

[21] *HTS means Harmonized Tariff Schedule. The U.S. 10-digit classification identifies imports for duty rates and regulatory requirements.*

[22] *USITC DataWeb unit series for metalworking machinery: NAICS 333511, 333514, 333515, 333517, and 333519. Only HTS lines measured by number are included.*

[23] *Krear, E., Harrison, W., Harp, T., Krusemark, L., and Faler, E. (2026). China's Automotive Surge: The Six 'S' Framework Underpinning China's Global Competitiveness. Center for Automotive Research, August 2026, p. 10, Figure 5 and note 23. https://www.cargroup.org/wp-content/uploads/2026/08/CAR_China_Whitepaper_MBS_2026.pdf*

[24] *Pat D'Eramo, Martinrea International, presentation at MBS 2026.*

[25] *Center for Automotive Research, China's Automotive Surge: The Six 'S' Framework Underpinning China's Global Competitiveness (August 2026), p. 9; CATARC, Construction of Intelligent Connected Vehicle Standard System in China, September 22, 2023, slide 4, https://www.itu.int/en/ITU-T/extcoop/cits/Documents/Meeting-20230922-e-meeting/12_CATARC_status_report.pdf; CATARC/CASRI, The 2024 Symposium on Intelligent Chassis Technologies and Regulations, agenda, p. 6, https://catarc.org.cn/upload/202404/30/202404301120068667.pdf. The tooling implications are CAR's interpretation of component standardization.*

[26] *Select cutting tools and consumables can be resourced more quickly; other tools may require lengthy qualification and validation, according to study participants.*

[27] *States are grouped by tool-and-die employment quartile; the bottom two quartiles are combined into one category. Dark blue: 1,900–9,500 workers; medium blue: 850–1,900; light blue: below 850. Alabama is not shown because of lagged Census reporting, as noted in the supplied slide. State ages refer to 2024; the national workforce comparison shown covers 2009 and 2025.*

[28] *Metalworking machinery comprises NAICS 333511, 333514, 333515, 333517, and 333519. Historical trade data use SIC through 1996 and NAICS thereafter.*

[29] *Table A1 reports unit volumes and shares only. Dollar values and shares for the combined four-country grouping were not available in the supplied data. The 1997 unit data are omitted because inconsistent reporting requirements left them incomplete. Changes in reporting conventions in 2019 limit comparisons with earlier years to directional trends.*