New Challenge of Value-Add:

Exploring Taiwan's Ability to Solve Engineering Challenges for High-Value Fasteners



› When Volume No Longer Creates Value: Taiwan's Fastener Industry at a Growth Crossroads

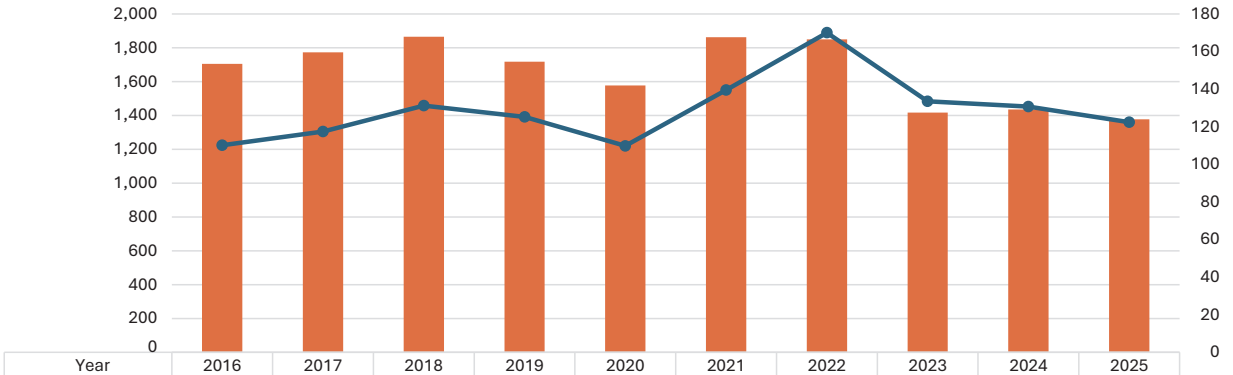
For decades, Taiwan's fastener industry has established a globally competitive and non-negligible position through its comprehensive industrial cluster, mature manufacturing technologies, and highly flexible supply chain. From wire rod, tooling, forming, heat treatment, and surface finishing to inspection and trading services, Taiwan offers a complete production ecosystem capable of meeting international customers' diverse needs, including high-mix, low-volume orders and fast delivery. However, as the competitive landscape of global manufacturing continues to evolve, a critical question must be addressed: Are the advantages that have driven Taiwan's fastener industry in the past still sufficient to support its next stage of development?

Over the past decade, Taiwan's fastener industry has recorded a compound annual growth rate of 5% each year (**Figure 1**). Fasteners are widely regarded as a typical mature manufacturing product, with demand distributed across automotive, machinery, construction, electronics, and various types of industrial equipment. Their broad range of applications, high substitutability, and relatively stable demand are defining market characteristics. However, stable demand does not necessarily translate into sustained industry growth. As technologies for standardized products become increasingly widespread and manufacturing capacity is no longer scarce, competition tends to revert to price, delivery time, and cost.

An examination of Taiwan's metal fastener exports from 2016 to 2025 reveals that export weight fell from 1.535 million tons to 1.239 million tons, a decline of approximately 19.3%. Meanwhile, export value increased from NT$122.46 billion to NT$135.97 billion, up approximately 11.0%. In other words, **Taiwan's fastener industry has seen its export volume contract while its average export unit price has continued to rise.**

However, looking at the period following the 2022 export peak, both export weight and value have declined significantly, indicating that the industry continues to face demand fluctuations and competitive pressure. Whether the increase in average unit prices genuinely reflects technological upgrade and higher value-added production remains a question that must be examined through changes in product mix and market competitiveness.

Fig. 1. Taiwan Fastener Export (2016-2025)



Year	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Export Weight	153.5	159.5	167.9	154.6	142.0	167.6	166.5	127.5	129.2	123.9
Export Value	1,224.6	1,305.6	1,458.9	1,392.0	1,220.5	1,550.3	1,888.9	1,483.1	1,452.5	1,359.7

Source: Taiwan Institute of Economic Research Customs Database / Compiled by Kristy Chi (October 2026)

Taken together, **Table 1** and **Figure 2** show that Taiwan's average export unit price has indeed increased, widening the price gap between Taiwan and China. However, the gap between Taiwan and higher-priced exporting countries remains substantial. In 2016, Taiwan's average unit price was approximately 1.56 times China's, rising to 1.84 times in 2025. Nevertheless, Germany's average unit price in 2025 was still 2.77 times Taiwan's, while Japan's was 2.31 times Taiwan's. Notably, Japan's average export unit price remained broadly within the range of US$7.9–8.6/kg over the decade, with no pronounced long-term upward trend. By contrast, the U.S. experienced a sharp increase in its average unit price after 2020. This increase, however, does not necessarily indicate technological advancement. Rising energy prices and inflation may also have contributed. In the author's view, the dramatic increase in the U.S. unit price may be more attributable to discrepancies arising from mirror trade statistics. When complete export data are unavailable from the U.S., import data reported by its trading partners may be used to estimate U.S. export performance in global customs databases, potentially resulting in statistical distortions.

For Taiwan, maintaining global competitiveness is becoming increasingly challenging. On the one hand, China and other emerging manufacturing economies continue to expand their supply capabilities while gradually improving product quality and process technologies. On the other hand, Taiwan faces mounting cost pressures from global inflation, higher energy prices, labor expenses, environmental regulations, and international trade policies. When products lack clear differentiation, manufacturers find it difficult to pass rising costs fully onto customers. Even if companies maintain a certain level of shipments, improvements in revenue and profitability do not necessarily follow.

The crisis facing a mature industry is not necessarily a sudden disappearance of market demand. Rather, it emerges when product technologies become increasingly accessible and competitors continue to multiply, while companies fail to strengthen their differentiation capabilities at the same pace. The result is a situation in which production volumes become difficult to expand, prices have limited room to rise, and profit margins come under pressure. Without the support of new applications, technologies, and business models, existing competitive advantages can gradually become constraints on future growth.

› Value-Adding Is Not About Charging More, but Becoming Irreplaceable

Under mounting competitive pressure in mature markets, "value-adding" has become one of the most frequently cited keywords in the transformation of Taiwan's traditional industries. But what does value-adding actually mean? Does it involve using more expensive materials, achieving tighter machining tolerances, or obtaining more international certifications?

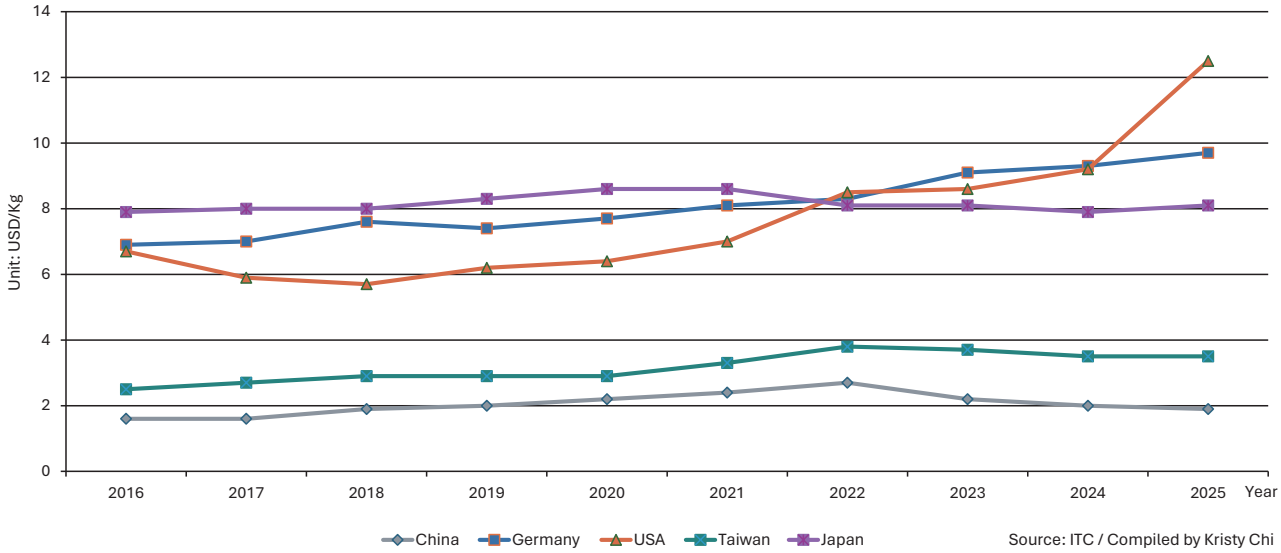
These factors are certainly important, but they do not automatically guarantee greater market value. Genuine value-adding should begin with two fundamental questions: What capabilities are customers willing to pay a premium for, and can suppliers consistently deliver value that competitors cannot readily replace?

Table 1. Comparison of Average Export Unit Prices Among the World's Top 5 Fastener Exporting Countries Over a Decade (Unit: US$/Kg)

Country	2016	2025	Change
China	1.6	1.9	+18.8%
Germany	6.9	9.7	+40.6%
USA	6.7	12.5	+86.6%
Taiwan	2.5	3.5	+40.0%
Japan	7.9	8.1	+2.5%

Source: ITC; compiled by Kristy Chi

Figure 2. Comparison of Average Export Unit Prices of Top 5 Exporting Countries Over the Past Decade



For fasteners, the basic function of screws and nuts is to join and secure components. Yet the engineering responsibilities they carry can vary enormously depending on the application. Standard fasteners used in ordinary furniture are primarily evaluated on cost, ease of assembly, and basic strength. Fasteners in automotive steering systems, by contrast, must withstand vibration, temperature fluctuations, corrosion, and performance changes resulting from long-term use. Those used in drones and aerospace equipment may face additional requirements, including lightweight design, high strength, fatigue resistance, and rigorous quality traceability. In other words, the value of a fastener cannot be determined solely by material weight, the number of manufacturing steps, or its price per piece. Its impact on overall system safety, reliability, and life-cycle costs must also be taken into account.

When fastener failure can lead to equipment downtime, product recalls, increased maintenance costs, or even threats to human safety, customers are purchasing more than components that meet dimensional specifications. They are paying for the assurance of consistent, long-term performance. Under these circumstances, fastener suppliers have an opportunity to evolve from manufacturers that passively follow customer drawings and specifications into engineering partners actively involved in material selection, structural design, process development, and performance validation.

However, value-adding does not mean every company must enter aerospace or other customized, low-volume markets. Fasteners used in construction, energy, and large-scale infrastructure projects may not command particularly high prices per piece. Nevertheless, engineering certifications, long-term supply commitments, installation efficiency, and economies of scale can create stable business models with substantial barriers to competition.

Taiwan's fastener industry therefore has at least 3 distinct pathways to value-adding: creating technological barriers through advanced materials and manufacturing processes; strengthening customer loyalty through reliability and safety performance; and increasing irreplaceability within the supply chain through integrated supply solutions and scalable service capabilities.

Looking ahead, the key question is not simply how many additional screws and nuts that AI, drones, or autonomous vehicles will require. More importantly, what new engineering challenges are these emerging applications creating that existing products cannot adequately address? And do Taiwanese manufacturers have the capabilities to turn these requirements into new products, validated performance solutions, and long-term orders?

As the global fastener market becomes less willing to pay a premium simply for expanded production capacity, the next stage of competition for Taiwan's industry will no longer be about who can manufacture more screws and nuts. It will be about who can solve more of the engineering problems behind fasteners—and who can help shape purchasing decisions.

› From Automotive and Drones to AI: Emerging Applications Are Redefining Fastener Value

As global manufacturing moves toward electrification, intelligence, and automation, growth opportunities for the fastener industry are driven not only by increases in the number of end products, but also by changes in equipment structures, operating environments, and reliability requirements. From automotive and drones to AI infrastructure, these seemingly different markets are collectively driving fasteners beyond their traditional role as joining components toward becoming critical elements responsible for safety, performance, and system reliability. However, the commercial value generated by each application varies considerably. Taiwanese manufacturers must therefore identify the specific characteristics of each market rather than judge its potential solely by the growth rate of the emerging industry it serves.

1. Automotive Modularization: Small Screws are Major Implications for Vehicle Safety

Based on observations at automotive exhibitions in Japan and Europe in recent years, the author has noted that as automotive electronics, electrification, and modular design become increasingly widespread, the number of components and fastening requirements in certain modules is becoming more complex. In areas such as steering systems, chassis, battery systems, sensors, and electronic control modules, fasteners must do more than provide basic connections. They must also deliver structural strength, vibration resistance, anti-loosening performance, corrosion resistance, and long-term stability. This does not necessarily mean that the total number of fasteners used in each vehicle will increase. Rather, the performance and quality consistency requirements for fasteners in specific functional modules are becoming increasingly demanding.

Volkswagen Group's recent large-scale vehicle recalls related to the risk of corrosion-induced failure in steering system bolts highlight the importance of fastener quality to automotive safety. When a particular fastener design is widely adopted across different vehicle models and brands, **modularization and component standardization can reduce development and procurement costs. However, when a quality issue occurs, they can also expand the scope of recalls and increase the associated costs of corrective action.**

It is worth noting that the technical challenge of automotive fasteners often lies not in meeting a single performance criterion, but in balancing multiple requirements. In a recent fastener testing case involving compliance with Volkswagen specifications that the author encountered, the products had to satisfy both coefficient-of-friction requirements and a four-week cyclic corrosion test. The results showed that none of the five samples passed the corrosion test in their original condition. However, after thermal aging at 120°C for 24 hours, all five samples passed. This finding suggests a potentially significant relationship among the degree of curing of the surface treatment system, process conditions, and corrosion resistance. The actual cause, however, requires further investigation and validation.

This testing case was not a direct failure analysis of the Volkswagen recall incident. Nevertheless, it illustrates a common challenge in high-value fastener manufacturing: improving corrosion resistance while maintaining an appropriate and consistent coefficient of friction to ensure proper assembly preload and long-term fastening reliability. For Taiwanese fastener manufacturers, **the ability to control manufacturing processes across materials, surface treatments, and assembly performance will be an important competitive requirement for entering higher-end automotive supply chains.**

2. Drone Applications: Limited Quantities, but Critical Components That Cannot Be Overlooked

Compared with the large-scale production of the automotive industry, drone applications present a very different demand profile for fasteners. During a visit to Commercial UAV Expo 2026 in the U.S. this year, the author observed that commercial drones are gradually moving beyond a primary focus on flight performance toward autonomous navigation, sensor fusion, extended operating time, and the ability to perform missions across different environments. As drone applications expand from aerial inspections to maritime monitoring, offshore facility inspections, disaster response, and defense, their components must also withstand increasingly complex operating conditions.

An examination of the structures of multirotor drones reveals that fasteners are widely used in arms, motor mounts, airframe structures, landing gear, payload equipment, and battery modules. Although the number of fasteners used in a single drone is far lower than that in an automobile, continuous vibration during flight, repeated takeoffs and landings, impact loads, and exposure to outdoor environments make fastener reliability a critical factor in overall aircraft safety.

This is particularly important for missions conducted along coastlines, offshore, or in high-humidity environments. In addition to adequate mechanical strength, fasteners must withstand salt-spray corrosion, galvanic corrosion caused by contact between dissimilar metals, and preload loss resulting from prolonged vibration. For drones designed with lightweight construction in mind, titanium alloys, high-strength steel, and other specialty fastener materials may offer different performance advantages. Nevertheless, material selection must take structural design, material compatibility, cost, and maintenance requirements into account.

More importantly, **the commercial value of drone fasteners should not be measured solely by the quantity used in each aircraft.** A single fastener installed at a critical structural location could cause a drone to lose its mission capability—or even crash—if it loosens or fractures. Consequently, fastener suppliers with expertise in anti-loosening designs, fatigue performance validation, corrosion protection, and quality traceability may have opportunities to evolve from general component manufacturers into critical supply partners for drone system manufacturers.

The drone market, however, also presents challenges, including limited order volumes, fragmented model specifications, and relatively high development and validation costs. To enter this market, Taiwanese fastener manufacturers should first identify common components with mass-production potential and standardized requirements. They should also assess whether the technologies developed for drones can be extended to robotics, aerospace equipment, or other high-reliability applications. This would help prevent substantial development investment from being tied up in markets that cannot generate sufficient economies of scale.

3. AI Equipment and Data Centers: A High-Growth Market Does Not Necessarily Mean Higher-Priced Fasteners

The rapid expansion of the AI industry is driving investment in servers, thermal management equipment, racks, power systems, and data center infrastructure, prompting the fastener industry to explore new business opportunities across the AI supply chain. However, the high technological content of AI equipment does not mean that every component used in these systems carries the same level of added value.

In AI servers, for example, fasteners used in enclosures, racks, and certain electronic equipment continue to be evaluated heavily on standardization, rapid assembly, automated production, and cost control. Even though a complete AI server may be worth considerably more than conventional equipment, this does not mean the unit price of its enclosure fasteners will increase proportionately. For many standardized products, competition may still center on price, delivery time, and reliable supply.

By contrast, **the large-scale construction of AI data centers may create another market opportunity worth watching: construction and engineering fasteners.** From structural steel connections and equipment foundations to electromechanical support systems, pipe hangers, anchors, and various fastening assemblies, data center construction requires substantial quantities of fasteners that meet consistent specifications, reliable installation requirements, and stringent engineering quality standards.

These products may not command particularly high prices per piece. Nevertheless, project scale, long-term supply contracts, installation efficiency, and quality certifications can help create relatively stable order streams. Data centers place particularly high demands on equipment uptime, cooling efficiency, and power system safety. Certain equipment mounting and support systems must also account for vibration, load-bearing capacity, and seismic performance, creating opportunities for suppliers with engineering expertise and validation capabilities to differentiate themselves.

Therefore, the opportunities AI creates for the fastener industry should not be estimated solely by counting the screws used in server enclosures. The analysis should encompass the broader construction, electromechanical, and equipment installation requirements of entire data centers. For Taiwanese manufacturers, leveraging existing capabilities in construction fasteners, specialty anchors, and industrial fasteners to enter international data center engineering supply chains may offer greater potential for scalable growth than simply pursuing orders for AI server components.

4. In the AI Era, the Real Value-Adding Opportunities May Lie in Thermal Management Systems and New Energy Equipment

AI consumes enormous amounts of electricity and generates substantial heat. One area that therefore deserves closer attention is the transformation of thermal management system design driven by the high power density of AI computing equipment. This trend is creating opportunities for precision fasteners in applications that go beyond conventional enclosure assembly. From heat sinks and vapor chambers to liquid-cooling cold plates and pipe fastening assemblies, fasteners do more than provide basic connections. They can directly affect thermal interface contact pressure, sealing reliability, and long-term operating stability. Under repeated thermal cycling and equipment vibration, maintaining the appropriate preload and preventing joint relaxation caused by differences in thermal expansion between materials have become important engineering considerations for certain cooling modules.

Similar requirements can also be found in hydrogen fuel cells and power electronics systems. As equipment becomes more compact and operates at higher power densities, certain thermal management and electronic modules use small fasteners such as M3 screws. The value of these fasteners depends less on material weight and more on precision assembly, surface treatment, and long-term reliability. For Taiwanese fastener manufacturers, greater involvement in cooling module design, fastening force control, and performance validation could create opportunities to move beyond supplying standard components and become collaborative development partners in thermal management systems (**Table 2**).

In summary, automotive, drone, and AI infrastructure applications represent three distinct sets of opportunities for the fastener industry. Automotive applications emphasize safety responsibilities and quality consistency; drones demand lightweight construction and reliability under challenging environmental conditions; and AI data centers combine large-scale engineering projects with long-term supply requirements. What these markets share is not simply a pursuit of higher unit prices, but a shift in fastener value from the component itself toward the reliability of the broader supply chain. For Taiwan's fastener industry, genuine value-adding is not about chasing every trending application. It is about selecting markets where existing manufacturing strengths can be leveraged, technological barriers can be established, and sustainable revenue streams can be developed.

Table 2. Analysis of Value Drivers for Precision Fasteners in the AI Era

Market Segment	Representative Fasteners	Key Value Drivers
Enclosures and racks	Standard screws, nuts, and riveted fasteners	High-volume supply, cost efficiency, and assembly productivity
AI liquid-cooling and thermal management modules	M2–M4 precision screws, spring-loaded screws, and specialty fastening components	Preload, contact pressure, thermal cycling performance, and sealing reliability
Data center construction and electromechanical systems	High-strength bolts, anchors, and support fasteners	Project scale, structural safety, certifications, and supply reliability

Source: Compiled by Kristy Chi, October 2026.

› High-Value Problem-Solving Capabilities of Global Fastener Companies: Lessons from Bossard and PEM

The next stage of competition for Taiwan's fastener industry is not about chasing trending sectors such as AI and drones, but about identifying the underlying engineering requirements of different applications. From automotive safety and drone reliability to precision thermal management and data center construction, **value-adding is not simply a matter of raising product prices. It means creating value that customers cannot easily replace through capabilities in materials, manufacturing processes, validation, and system integration.**

The transformation strategies of international fastener companies offer more concrete lessons for Taiwanese manufacturers. Switzerland-based Bossard Group, for example, has moved beyond fastener trading as its core competitive focus. By integrating product selection, assembly engineering support, and smart logistics management, the company helps customers improve product design, assembly efficiency, and fastener inventory management. When a supplier's professional services become embedded in a customer's R&D, procurement, and production processes, its value is no longer determined solely by the price of an individual screw. Instead, it depends on its ability to reduce the customer's total cost of ownership and supply chain risks.

Another noteworthy example is PEM, a brand under U.S.-based PennEngineering. PEM specializes in self-clinching fasteners, press-in nuts, and precision fastening technologies. Through product design, installation methods, and application engineering support, it helps customers solve fastening challenges involving sheet metal, electronic equipment, and precision assemblies. As AI servers and associated cooling equipment become increasingly complex in design, the need for precision fastening, space optimization, assembly efficiency, and reliability is creating more applications for these fastening technologies.

It is worth noting that Taiwanese fastener manufacturers are already part of the supply chains of Bossard and PEM. This indicates that Taiwan's manufacturing capabilities are not entirely disconnected from these international high-value supply chains. However, being a supplier does not necessarily mean that every product supplied is used directly in AI equipment, nor does it automatically indicate that Taiwanese suppliers have gained design leadership over the end products. A more important question is whether Taiwanese manufacturers can build on their existing supply relationships to gradually participate in material selection, product development, performance validation, and application design, thereby accumulating their own engineering problem-solving capabilities beyond manufacturing.

The value-adding strategies demonstrated by Bossard and PEM share an important lesson: in the AI era, fastener opportunities are not merely about increasing consumption volumes, but about addressing increasingly complex assembly and reliability requirements. For Taiwanese fastener manufacturers, securing orders in emerging markets should not be the end goal of transformation. Every customer validation process and joint development project should instead become an opportunity to accumulate technical knowledge and strengthen market influence. As Taiwan's fastener industry faces the challenges of the next 5 years, one fundamental question deserves serious consideration: What have Taiwanese fastener manufacturers actually accumulated over the past few years? More customers, higher revenue, and greater production capacity—or competitive advantages that others cannot easily replicate? ■

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