The Competitiveness of Taiwan's Metal Startups Under Global Transformation Pressures

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Introduction

Global supply chains are undergoing structural transformation driven by geopolitical tensions, decarbonization policies, and the rapid adoption of smart manufacturing. Taiwan's manufacturing model—characterized by cost efficiency and flexible production networks—is facing mounting pressure under these shifts. An aging workforce, carbon border measures such as the Carbon Border Adjustment Mechanism (CBAM), and rising geopolitical risks are accelerating the transition toward more stringent regulatory and technological requirements.

In this evolving context, global markets increasingly require traceability in material sourcing, higher process reliability, and end-to-end supply chain transparency. Hence, this article introduces four types of metal startups: 1. **Reconfiguring Raw Materials**: Toward Circularity (material autonomy), 2. **Moving Upstream in Standards** (standard-setting), 3. **Upgrading Manufacturing** (high-end supply chain integration), and 4. **Expanding into Services** (system and service solutions).

1. Reconfiguring Raw Materials: Toward Circularity

At the upstream level, startups are reducing dependence on primary resource extraction while mitigating geopolitical exposure through recycling technologies. **Lianyou Resources Co., Ltd**. has developed patented low-carbon processes for recovering hard metal scrap and refining high-purity materials, including tungsten and cobalt. These capabilities, supported by international certifications, have enabled the company to integrate into global supply chains and serve clients such as TSMC, Apple, and Tesla.

At the same time, firms such as **UWin Resource Regeneration Inc.** are entering the lithium battery recycling sector. Their activities reflect broader efforts to establish material autonomy in response to the energy transition. Collectively, these developments suggest that circular material systems are moving beyond niche

applications and becoming increasingly relevant to participation in global supply chains.

2. Moving Upstream in Standards: Material Innovation and Specification Power

At the specification stage, startups are moving beyond traditional contract manufacturing roles by engaging earlier in material development and standards formation. **Chung Yo Materials CO., LTD.**, a subsidiary of **Chia Yi Steel CO., LTD.**, leverages metallurgical expertise alongside its patented Vacuum Induction Melting Inert Gas Atomization (VIGA) technology to produce high-quality metal powders for additive manufacturing. This capability helps address Taiwan's long-standing reliance on imported aerospace- and medical-grade materials.

The company has also begun collaborating with equipment manufacturers in co-developing material specifications, indicating a potential shift from component supply toward influence over technical standards. Other firms, including **High-Entropy Materials Co., Ltd.** and **Best Metal Material Co., Ltd.**, are advancing proprietary capabilities in next-generation alloys and non-precious metal substitution. These developments point to a gradual shift in competitiveness from manufacturing capacity toward control over material specifications and innovation pathways.

3. Upgrading Manufacturing: Integration into High-End Supply Chains

In manufacturing, startups are strengthening their position in high-end hardware supply chains through proprietary technologies, patented processes, and strategic partnerships. **Taiwan Metal Precision Co., Ltd.** has enhanced production precision and efficiency through its proprietary one-piece A.I.T. manufacturing process. With strategic investment from AURAS Technology, the firm has aligned with AI server rack supply chains, leveraging complementarities in engineering and production.

Its participation in the Open Compute Project (OCP) in 2023 suggests increasing engagement with global data center standards. Meanwhile, **Yong Ju Precision Technology Co., Ltd.** and **JIN HUI Co., Ltd.** Technology are expanding downstream processing capabilities, supported by industrial partners such as Evergreen Aviation Technologies and venture capital investors such as **Gudeng Venture Capital CO,. Ltd.**. These developments indicate that technical capability alone is increasingly insufficient; integration into broader industrial ecosystems and alignment with leading platforms are becoming critical to competitiveness.

4. Expanding into Services: From Manufacturing to System Solutions

At the downstream end, some startups are extending beyond manufacturing into system-level solutions and data-driven services. **Oasense Company** provides an illustrative example: its smart showerhead integrates energy generation and sensing technologies within a metal-based structure, enabling water usage to be monitored and incorporated into feedback-driven systems. This approach shifts value creation from hardware production toward service-oriented and data-enabled models.

More broadly, this trend suggests a potential redefinition of the metal industry's role. Rather than functioning solely as a manufacturing base, it is increasingly participating in data ecosystems and integrated service platforms.

A Co-Creation Model—and Its Risks

One contributing factor behind these developments is the emergence of a "large-leading-small" co-creation model. Large firms are increasingly engaging startups as platforms for technological experimentation through strategic investment, while startups gain access to capital, production capacity, and market credibility.

However, this model also introduces structural risks. Circular economy initiatives that fail to meet international certification standards may remain confined to local markets. Digitalization that is limited to automation, without integration into decision-making systems, may not generate sustainable competitive advantages. Additionally, if startups are positioned primarily as cost-reduction tools, their innovations risk being absorbed by larger firms without contributing to independent capability development.

Conclusion: From Efficiency to System-Level Competitiveness

This article outlines four types of transformation models for metal startups. A key policy question is whether Taiwan can institutionalize these transformations into internationally recognized standards across materials, manufacturing processes, and services, particularly given the challenges startups face in achieving industrialization and scaling up production. This will determine whether Taiwan can move beyond an efficiency-oriented manufacturing model and become a critical node in the global industrial system, where competitiveness is shaped not only by production capacity but also by material autonomy and system integration capabilities.