The core strategy and structure of South Koreas robot industry monetization in the AI data scarcity era

The rapid advancement of artificial intelligence (AI) has become inseparable from the development of the robotics industry. However, a pressing challenge has emerged: the depletion of essential AI training data. Traditional data sources such as language, speech, and video are no longer sufficient. Instead, there is an increasing demand for data related to physical interactions and forces. This shift raises a critical question for manufacturing powerhouses like South Korea: how can the nation maintain its competitive edge amid these evolving demands? Understanding the strategies that can navigate this new landscape is essential for sustaining growth and innovation.

Investment in robotics has surged dramatically, signaling the arrival of what many call the “robot era.” Beyond being cultural icons, robots are becoming central to both industry and daily life. Unlike previous waves, such as Japan’s humanoid robot boom, today’s robotics revolution is underpinned by significant AI breakthroughs, promising more practical and enduring transformations. Robots serve as the physical embodiment of AI, enabling it to move beyond virtual environments into the tangible world. This integration is reshaping the industrial landscape and creating new opportunities for countries with strong manufacturing foundations.

At the heart of AI lies the acquisition of vast, high-quality datasets to train models and develop services. Yet, as these datasets become scarce, the need for novel types of data—especially those capturing physical forces and tactile sensations—has become urgent. In human interactions, force data is as crucial as voice or visual information, and robots are uniquely positioned to collect this data. Consequently, AI and robotics are mutually reinforcing fields, with the robotics industry poised to evolve alongside AI advancements.

Historically, robots operated based on pre-programmed behaviors derived from mathematical calculations. The introduction of AI has revolutionized this approach by enabling near-limitless iterative learning through computer simulations. For example, a robot can repeatedly practice moving a cup without spilling, refining its motions through AI-driven optimization. However, the physical world presents complexities such as friction and irregular forces that simulations struggle to replicate

perfectly. Bridging this “sim-to-real gap” remains a core challenge in robotic control.

Robot design has also adapted to favor simulation compatibility. Structures with centralized mass and relatively lightweight limbs facilitate easier control and simulation. While complex actuator systems may enhance real-world performance, they complicate simulation processes. Modern robot design thus balances real-world safety and usability with simulation efficiency, reflecting the intertwined nature of physical and virtual development.

The robotics industries in China and the United States illustrate contrasting approaches. The U.S. emphasizes AI-driven robotics led by major IT companies, focusing on simulation and control through software intelligence. China, meanwhile, prioritizes mechanical engineering and hardware robustness. Chinese robots often excel in mechanical performance, whereas American robots leverage AI for sophisticated control. Despite these differences, global collaboration is evident: U.S. robots frequently incorporate Chinese components, and Chinese robots utilize American simulation technologies. This complex interplay of competition and cooperation shapes the global robotics ecosystem.

Robotic intelligence operates across multiple hierarchical levels, resembling the human nervous system. Control is distributed from physical actuators to higher-level algorithms and overarching intelligence. AI does not replace all control functions; mathematical models and physics-based algorithms remain vital. The U.S. tends to focus more on AI-centric control, while China emphasizes physics-based control methods. This distinction highlights the diverse philosophies shaping robotic development.

For South Korea, the path forward must consider the difficulty of acquiring massive datasets. Developing robotic systems that achieve high performance with limited data is crucial. This involves solving physical control challenges to reduce the data required for AI training while ensuring safety and reliability. Leveraging the country’s manufacturing expertise, wearable robot technologies that digitize the craftsmanship and experience of skilled workers offer a unique competitive advantage. Recording artisans’ movements through wearable suits to generate valuable data exemplifies this approach, positioning South Korea distinctively in the global market.

This strategy extends beyond technology development to encompass industry-wide collaboration and knowledge sharing. Domestic initiatives like the “Humanoid Manufacturing AX Alliance” emphasize

cooperation over competition, fostering an industrial platform model. Amid the intense rivalry between the U.S. and China, South Korea's pursuit of an independent yet collaborative robotics ecosystem tailored to its manufacturing strengths represents a promising direction.

To deepen our understanding of the broader economic context influencing these technological trends, it is instructive to consider perspectives from leading economic experts. Their analyses provide insight into how current economic conditions and policy environments intersect with the evolution of robotics and AI industries, shaping strategic decisions for nations like South Korea.

Expert	Core Perspective	Keywords	Interpretation Point
Ray Dalio	Economy is at a structural inflection point driven by technological innovation.	Economic cycles, technological innovation, structural change	Advancement in AI and robotics signals a new growth phase, urging manufacturing leaders like South Korea to harness technology fusion for renewed economic momentum.
Paul Krugman	Macroeconomic policies and global supply chain shifts are critical for recovery and growth.	Macroeconomic policy, supply chains, growth strategy	Robotics and AI are central to reshaping global supply chains, making policy support and international cooperation essential for sustainable economic expansion.
Milton Friedman	Market freedom and competition drive innovation; government intervention should be minimal.	Market freedom, competition, government role	Robotics industry progress should rely on market-led innovation, cautioning that excessive government involvement may hinder

			competitiveness.

These expert viewpoints collectively reveal that the economy is undergoing a multifaceted transformation influenced by technological breakthroughs, policy frameworks, and market dynamics. Dalio emphasizes the emergence of a new growth cycle fueled by innovation, while Krugman highlights the importance of policy and supply chain realignment in supporting this growth. Friedman advocates for preserving market autonomy to foster innovation. Together, these perspectives underscore the complexity of economic evolution and the need for balanced strategies that integrate technology, policy, and market forces.

The critical insight is that the current economic environment is not merely cyclical but structurally evolving through the interplay of innovation, global collaboration, and shifting market conditions. Robotics and AI industries are no longer peripheral but central to economic competitiveness and growth. Achieving a harmonious balance between supportive policies, industrial cooperation, and market-driven innovation is vital. South Korea's focus on combining manufacturing expertise with AI-based robotic systems designed for efficiency with limited data aligns well with these broader economic trends.

Given these considerations, it is worthwhile to reflect on how your own industry or investment approach aligns with the ongoing technological and economic transformations, and what strategic adjustments may be necessary to remain resilient and competitive.

For a concise review of the key points discussed, the PDF summary provided below offers a practical reference that can facilitate efficient revisiting of the core ideas. This resource may prove valuable for future consultation and deeper understanding.