

Battle Lines

Technology Rivalry
and the Rise of
Nationalism

Cover Story



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The world is at the advent of a 4th Industrial Revolution. Advances in artificial intelligence, machine learning, Big Data and the so-called Internet of Things, among other things, promise to upend business models around the world and change the way we live in unimaginable ways. But the re-emergence of nationalism as a potent force in geopolitical rivalry threatens the global spread of this new technological transformation. Asia will be an important battleground in this looming 'technology war.'

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Redrawing Korea's Industrial Map

By Sung-Chul Shin

One of the hallmarks of South Korea's modern history is the remarkable speed with which it catapulted itself from the rubble and poverty of the Korean War to become one of the world's leading economies.

But despite the technological competitiveness of many of its large conglomerates, the challenges of the coming Fourth Industrial Revolution will require transformational thinking by the country's government, businesses, scientists and educators, writes Sung-Chul Shin.

"IT WILL TAKE at least 100 years to rebuild this country," Gen. Douglas MacArthur once said as he faced the war-ravaged cities of Korea while leading the United Nations forces during the Korean War. As one of the world's poorest countries, post-war Korea's per capita gross domestic product was less than US\$67. Contrary to MacArthur's prediction, however, South Korea recuperated from war-stricken poverty in just over half a century. The country has achieved industrialization, democratization, informatization and globalization. Many might be surprised to find that it is the only country to have achieved all four nearly simultaneously in this short period of time. More notably, this compressed growth has made the country one of the world's top ten economies, earning the title, "the Miracle on the Han River."

All economic indicators underscore South Korea's impressive growth. GDP increased 720-fold from 1962 to 2018, to become the 11th highest in the world, with per capita GDP growing 340-fold; and export volume rose more than 10,000-fold to become fifth in the world.

The growth of the R&D sector has also buttressed economic development. Prior to 1977, South Korea had not one published paper listed in the Science Citation Index (SCI). Today, nearly 60,000 SCI papers have been published, placing Korea 12th in the world. Before 1984, Korea had no US patents registered. Now, it has nearly 20,000, the fourth largest number in the world. What made such phenomenal growth possible? I believe there are three key components.

First and foremost, there were many visionary leaders in government, industry and the science

and technology community who had innovative ideas to help the country surge ahead. We also had the well-written strategic economic plans of government technocrats, who have implemented seven such five-year plans since 1962. All were strong advocates of science and technology and aligned economic development with technological advancement. Such ideas paved the way for the Korea Advanced Institute of Science and Technology (KAIST) and the state-funded research institute complexes that created an advanced technological infrastructure in South Korea. Lastly, without the passionate Korean people, who worked tirelessly to claw their way out of poverty, none of this would have been possible.

But these inexorable strides have stagnated in recent years. The important decisions that the country makes now will either lead us forward or see us trapped as a middle-income nation. When President Moon Jae-In took office in 2017, he declared the Fourth Industrial Revolution to be a new growth engine and launched a committee under his office to focus on that revolution.

MEGATRENDS

The Fourth Industrial Revolution will lead to great transformations worldwide. It will occur at unprecedented speed, and its breadth and depth will challenge long-held beliefs and upend socioeconomic traditions. Three new megatrends will affect human society.

First, hyperconnectivity is the most distinct feature. Now, 65 percent of the world's population uses mobile phones and 48 percent use the Internet. There are also more than 28 billion devices connected via the Internet of Things (IoT), and practically all electronic devices in the world are anticipated to be interconnected within 30 years. In addition to these gadgets, collective intelligence, collaboration via crowdsourcing and a sharing economy will hyperconnect all of us.

The second megatrend is superintelligence. The American futurist Ray Kurzweil predicted that the rapid development of artificial intelligence will bring about a significant singularity point within 30 years. When Google's AI program, AlphaGo, won a landslide victory against Go champion Lee Se-Dol, we had to admit that AI had finally arrived. Superintelligence processed through deep learning, brain science and Big Data will be embedded into the social infrastructure. Soon after, AI robots — which I call "Robo sapiens" — will be omnipresent.

The third trend is meta-convergence. New knowledge and innovation happen across inter- and multidisciplinary domains. The technological convergence of nano, bio, information and cognitive science, or NBIC, requires a new paradigm of sustainable development.

Moreover, we will soon live in a society where physical, cyber and biological systems are conjoined by sensing, communication, computation and control, which will combine to create "the meta-convergence world." For example, a smart industry combining the technologies of smart cars, smart cities, smart factories, and fintech will be fully realized through converging AI with Big Data, IoT, cloud computing and 5G.

CHALLENGES AND OPPORTUNITIES

Both challenges and opportunities lie ahead for South Korea in responding to this transformation.

Above all, fostering talent that will produce convergent knowledge and innovation is an urgent priority. Although the country has the world's highest university graduation rate, the quality of our education does not seem to be at the same high level. One report says that South Korea ranks 49th when evaluating how a university education addresses the needs of a competitive economy.

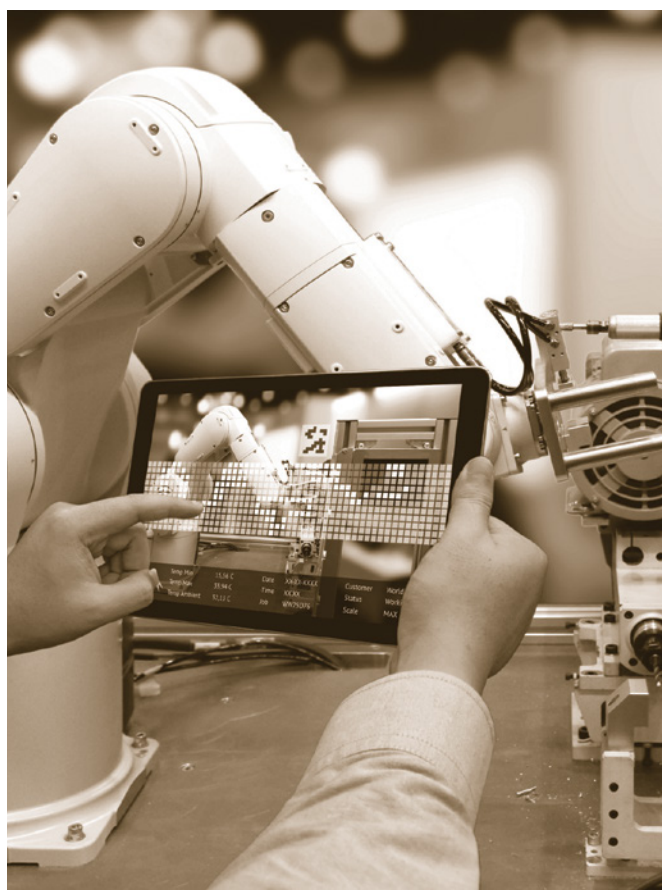
The Korean R&D sector has achieved impressive quantitative growth, but it needs to improve

its quality. Korea has made phenomenal growth in the publication of SCI papers and registration of patents. However, this numerical growth has yielded a poor number of paper citations. Even worse, we still have a technology trade deficit, paying about US\$4 billion annually for technology transfer. South Korea holds only 3 percent of the world's AI patents, far behind the US (47 percent), China (19 percent) and Japan (15 percent).

An economic landscape led by large conglomerates, as is the case in South Korea, has built-in vulnerabilities. For instance, while only 0.05 percent of Korean companies are large conglomerates, they account for 62 percent of total export volume. Meanwhile, 99.8 percent of Korean companies are small- and medium-sized enterprises (SMEs), which account for only 19 percent of export volume. If these giant conglomerates are shaken, the whole Korean economy will feel the tremors. Furthermore, Korea has been very conservative about engaging in rapid deregulation. According to the 2018 IMD World Competitive Rankings, South Korea's legal and regulatory framework hampering deregulation is ranked 58th in the world.

However, we also see tremendous opportunities ahead. The country's IT infrastructure is unsurpassed and its global market share in many IT products leads the world. Semiconductor memory at 58 percent (1st); screen displays, 47 percent (1st); and smartphone penetration, 23 percent (2nd) are just a few examples. In addition to the world's fastest Internet speeds, the new era of 5G will begin in March. Further, Korea's competitiveness in the manufacturing sector ranks fifth globally, and the World Economic Forum (WEF) evaluates Korea as one of the global leaders in readiness for the future of production.

Lastly, there is strong nationwide interest in this great wave. According to a survey, 96 percent of the Korean scientific community is very



positively interested in the Fourth Industrial Revolution. The scientists are not alone. Political parties are also ready for the new transformation. Taken together, I believe we can leverage the Fourth Industrial Revolution to create a new growth engine.

NATIONAL VISION AND STRATEGIC AREAS

All of our policies should focus on ensuring a human-centered society and benefiting humanity during the emergent changes. We need a national vision and strategy to realize a better quality of life during the Fourth Industrial Revolution.

AI will be the enabler of major industries. AI's significant progress will be vital for innovations in Big Data, IoT, 5G, autonomous vehicles, drones, robots, blockchain, precision medicine and smart cities. The government has implemented very ambitious national plans to boost AI-applied education and industries. Major companies including Samsung and LG are also making aggressive investments in R&D, recruiting talent and pursuing mergers and acquisitions. The Ministry of Science and ICT plans to launch six AI graduate schools by 2022, nurture 5,400 AI experts and invest US\$2 billion in the R&D sector.

One crucial national agenda item is implementing blockchain-based digital credit. To this end,

the government is focusing on building fundamental technologies, then expanding the applications before finally moving on to full-fledged service in a three-stage plan.

Precision medicine is also very important, considering South Korea's rapidly aging population. We expect a third of the population will be senior citizens by 2040. Therefore, cutting health-care costs through precision medicine is crucial for the government and the healthcare industry. Key strategies for boosting precision medicine include building an efficient system for collecting well-organized clinical genome Big Data and preparing a standardized open-data platform. This will help the government implement consistent policies with appropriate regulations.

KOREA'S EQUATION FOR SUCCESS

Weighing all of these challenges and opportunities, we can come up with a unique equation for success. From my perspective, the three most important factors are innovation in higher education, collaboration among university-industry-government and speedy deregulation.

First, the core of innovation in higher education is to foster the talent required for new industrial demand. The American philosopher and educational reformer John Dewey once pointed out that if we teach today's students as we taught yesterday's, we rob them of tomorrow. What kind of talent do we need to foster tomorrow's successes? I suggest developing what I call C³ talents — Individuals who brave new *challenges* and utilize *creativity* to solve problems but also exhibit a *caring* attitude and ethical responsibility.

As one of the ways to instill these C³ values in our young students, we have proposed novel educational methodologies. For instance, a non-departmental educational system is being newly implemented for undergraduates in Korean universities including KAIST and the Daegu Gyeong-

buk Institute of Science and Technology (DGIST). For three years, students will build a solid background in basic sciences, leadership and entrepreneurship. When these students become seniors, they will choose a customized-education track depending on their future career paths.

Secondly, close collaboration among university-industry-government, or “triple-helix collaboration,” is extremely important since South Korean R&D resources are weaker than those of China and Japan. The R&D budget of South Korea has increased by 11 percent annually over the last 20 years, and now stands at US\$73 billion. Still, according to a UNESCO report, this is only 20.6 percent of China’s and 43 percent of Japan’s. Meanwhile, the total number of R&D sector researchers in Korea accounts for only 11.5 percent of China’s and 51 percent of Japan’s.

Therefore, R&D resources should be managed effectively via this triple-helix collaboration to yield highly competitive R&D outputs. For this purpose, the national policy is shifting from a fast-following and short-term investment to a first-moving and long-term one. National funding is also increasingly being allocated to convergence research projects.

SMEs and startups are the real players that will jumpstart the economy. Therefore, the government plans to foster more SMEs and startups to sustain the economy. Because SMEs do not have enough internal resources for reskilling and upskilling, collaboration with universities is crucial for building their competitiveness.

Moreover, smart factories will be the norm in the Fourth Industrial Revolution. This sector is expected to create approximately 7.3 million new jobs in South Korea by 2030. It is also reported that when moving to a smart factory system for manufacturing smartphone boards, productivity will increase 37 percent while lowering the defect rate by 75 percent. Many South Korean universi-

ties, including KAIST, are retraining SME workforces to be specialists in the fields of IoT sensors, AI and Big Data for their smart systems.

Lastly, speedy deregulation is instrumental for getting ahead in this competitive race. South Korea’s “positive regulation system” drags out the process of commercialization, constraining market competitiveness. For example, Japan gave the green light to its unmanned vehicle businesses, allowing all its roads to act as test beds. But South Korea can only operate unmanned vehicles on a very limited number of roads. China has permitted the use of telemedicine via wearable devices. In South Korea, however, the telemedicine industry remains fundamentally blocked.

The regulatory sandbox concept is taking off worldwide as many governments vie to encourage innovation. The South Korean government responded by adopting this new approach in January, which exempted or delayed existing regulations for a certain period of time when introducing new products or services.

With the opening of the regulatory sandbox, the urban hydrogen car-charging station business and remote telemedicine services are under way. The ECG (electrocardiogram) watch will expand the area of customized 24-hour health-care services through genome analysis and will be available direct-to-consumer.

Even though South Korea has achieved miraculous growth during the past half century, it is now facing a tipping point. By designing an equation for success and aligning it with the imminent changes facing the country, I believe the world will witness another miracle on the Han River during the Fourth Industrial Revolution.

Sung-Chul Shin is President of the Korea Advanced Institute of Science and Technology (KAIST).

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