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CES 2021: Tasks for Korean Industries in a Digitally-Transformed World

| Summary |

CES 2021, an annual consumer electronics exposition, featured innovative products for the "changed-everyday" that is expected to characterize the post-COVID-19 world. Such products demonstrate that the so-called "digital transformation" is already well underway.

AI is now a mandatory foundational technology across industries. Innovation is particularly visible in AI and 5G-based areas, including "home-conomy" (home + economy), bio-health, and eco-friendly technologies.

▣ Korean Innovation Outcomes

Korea received more innovation awards this year than it did in 2020. However, Small and Mid-size Enterprises (SMEs) received relatively few awards.

Korea received more than one-quarter (26.4 percent) of all awards given, a proportion higher than the 21.8 percent Korea received in 2020. However, SMEs accounted for fewer awards than in 2020.

Of the 45 total awards Korea received in the Health & Wellness category, SMEs received 10, a relatively large number. However, the majority of these awards were for wellness and beauty products rather than for applications such as remote medical care (telehealth).

▣ Threats

Two factors threaten Korea's digital transformation: 1) a lack of AI capabilities and 2) systemic rigidity in bio-health.

Korea maintains the lead in 5G and IT manufacturing. However, this lead is jeopardized by vulnerabilities in the country's AI technologies and platform-related capabilities as well as by excessive regulatory control over remote medical care.

▣ Policy Recommendations

In order to dominate the convergence-based new product and services market and gain a competitive edge in the current era of digital transformation, Korea must develop innovative strategies, take bold steps, and never hesitate to break the mold.

The following measures are necessary: promote an open innovation industrial environment, address industry weaknesses via mergers and acquisitions (M&A), develop core technologies based on expected future demand, strategically strengthen platform capabilities, and undertake systemic reform to create an industrial environment conducive to the digital transformation.

1. Effects of COVID-19

For the first time, CES 2021 was held online in its entirety due to the COVID-19 pandemic. Some companies participated in online conferences and events, while others from major countries had virtual pavilions to showcase their digital technologies and products. Korea's LG Electronics featured virtual influencer Reah Keem, whose voice and movements were created with AI technologies.

Moreover, attendance was at a drastically smaller scale this year. The total number of participating companies decreased from approximately 4,400 in 2020 to 1,960 in 2021.[1] Due to COVID-19 and the effects of the ongoing U.S.-China trade dispute, the number of participating Chinese companies dropped to 205 compared to 1,368 in 2020 (China had the largest corporate presence at CES 2020). Many of the country's prominent companies including Huawei, Haier, Midea, and Xiaomi did not participate this year.

▣ Contactless Services and Products

The COVID-19 pandemic altered individuals' daily routines and lifestyles to become more home-centric and contactless. CES 2021 showed that such changes in consumption trends are having a significant impact on the ways in which companies pursue innovation.

In all categories, the spotlight was focused on contactless services and products, including smart homes and commercial robots for home-related demand as well as healthcare technologies for personal health management and disease prevention. The mobility sector focused on the eco-friendliness of electric cars and sustainability through self-driving cars.

Many major vehicle companies including Volkswagen, Toyota, and Hyundai Motor were not featured at CES 2021. GM proposed a vision for the auto industry through a presentation of its electric cars, self-driving cars, and unmanned vertical takeoff vehicles.

▣ A Focus on AI, 5G and Inter-Industrial Convergence to Accelerate the Digital Transformation

CES 2021 showed that the digital transformation is unfolding quickly due to both COVID-19-related market changes as well as the advancement of AI, IoT and 5G-based new technologies and services.

1) No. of CES participating-companies per country (2020→2021): USA: 1,933→560, China: 1,368→205, Korea: 390→349, France: 279→135, Japan 73→77

Many participating companies introduced products or services outfitted with digitally-transformative technology. This includes a noticeable increase in online contactless services such as remote medical care and education. Most large companies announced plans to utilize AI to provide 5G network-based services. AI and 5G are increasingly recognized as universal technologies by digital transformation-practicing companies and will be applied primarily to home-economy areas, bio-health and eco-friendly innovation.[2)]

2. AI as a Necessity

Based on 2021 predictions with the rapid development of IoT and 5G, AI is being universally applied to diverse industries and areas of everyday life such as smart homes, bio-health, and automobiles. The world is approaching an era in which AI is a necessity. The application of AI is expected to result in innovations in productivity for companies and offer a higher quality of life, safety, and eco-friendliness for consumers.

Major AI applications highlighted at CES 2021 include self-driving vehicles, bio-health and the smart home. The global market is expected to soon feature even more corporate competition in these areas.

AI technology is developing highly sophisticated functions to be able to understand, learn, and assist with consumers' lives. The transformation of home appliances, automobiles, and mobile devices into intelligent versions is occurring at a rapid pace.

Moreover, CES 2021 showed that smart homes are becoming more effective in consumers' daily lives with the use of AI and edge computing. Smart homes outfitted with Edge AI represent a technology that can independently process data within the home. Edge AI is easy to install and has enhanced security features for protecting personal information with low latency.[3)]

In the mobility sector, there is intense competition between Original Equipment Manufacturers (OEMs) in the automobile industry and ICT (Information,

2) In its first keynote speech, Verizon emphasized the rise of the "5G+X" phenomenon referring to the application of 5G technology to diverse areas including sports, shipping/transport, education, and cultural performance.

3) Edge computing refers to the processing of data on widely distributed small servers and readers. Edge AI refers to the relatively simple AI functions (reading, image, and spatial recognition) that occur on a reader or on an adjacent network.

Communication and Technology) companies over the development of AI chips for self-driving cars. Tesla was the first in its industry to develop an AI chip for self-driving cars. Apple is also planning to independently develop a vehicle AI chip.

▣ The Expansion of 5G and Intensified Competition for Market Dominance in 2021

Investment in 5G, which offers an ultra-connected, ultra-fast, and low-latency communications environment, is expected to increase significantly this year. This includes intensified competition for dominance over 5G-based convergence in diverse sectors such as bio-medical care, mobility, education, distribution, and manufacturing.

5G has become a core technology and a critical component of the infrastructure for contactless services, such as work from home (WFH), remote learning, video conferencing, e-sports, and security. The need for 5G-based technologies and services to meet changing demand was bolstered by the COVID-19 pandemic.

5G is also expected to fortify the data systems of public service infrastructure including garbage processing, electricity, waterworks, and heating. This will make it easier to achieve both data transparency and speeds which were virtually impossible in the past.

▣ ESG Management

The corporate value most emphasized at CES 2021 was ESG (environment, society, governance) management, metrics that are highly responsive to sustainability and environmental issues.

Interest in and the importance of ESG management within companies is growing due to a universal recognition of the need for eco-friendly practices such as Carbon Net Zero and sustainable growth. Several companies demonstrated steps they are taking to improve ESG. Samsung will be expanding its use of “eco-packaging” by upcycling delivery boxes for other purposes. In addition, remote controls powered by solar batteries and recycled plastic will be applied more broadly. LG Electronics stated that it will utilize more eco-friendly elements when applicable including fewer substances that may cause “sick building syndrome” and no carcinogenic substances in parts. The company also pledged to increase the use of recyclable or regenerated plastics. GM emphasized the importance of

corporate social responsibility (CSR) and underscored its vision of "Zero crashes. Zero emissions. Zero congestion."

▣ Home-conomy

One consequence of the COVID-19 pandemic has been the proliferation of a contactless economy because more content and services are being used in the home. This expansion of the contactless economy is expected to accelerate the development of the home-conomy.

Since the start of the COVID-19 pandemic, the home has become a source of demand for various kinds of digital services for work (WFH and video conferencing), education, court proceedings, fitness, and entertainment.

Table 1. Innovative Examples of Home Services (including software and content) at CES 2021

Company name	Category	Product name	Product description
Samsung Electronics	TV	Accessibility	TV viewing assistance for hearing/vision-impaired individuals
	Smart home	SmartThings Pet · Health · Cook	Provides pet care, home fitness, and cooking services
Mercedes-Benz	Car Infotainment	Mercedes Travel Knowledge	Audio guidance for location-related questions asked while driving
Moen Incorporated	Home Appliances	U by Moen™ Smart Faucet	Smart home-linked kitchen faucets (can be operated by voice, handle, or an app)
OrCam Technologies	Miscellaneous Devices	OrCam Read	Personal AI text regenerator (reader)
ROLI	Miscellaneous devices	LUMI Keys 1	Piano learning device for home use (integrated platform for hardware, software, and content)
The Chamberlain Group	Smart home	myQ Pet Portal	Smart door service for taking care of pets
Vanguard Industries	Robots	MOFLIN	An AI pet robot that is capable of learning and emotional communication
Voiceitt	Miscellaneous Devices	Voiceitt	An app that helps those with language difficulties to communicate with smart helpers or a smart home

Source: created by KIET based on CES 2021 website.

Innovation-related outcomes were concentrated in software and services rather than hardware. This suggests that diverse services and content made to satisfy individuals and/or families will expand very quickly.

▣ Merging of Automobile Technology and Home Appliances to Create New Sources of Demand and Change Technology Markets

Major home appliance companies are expanding their electronic product categories for use in automobiles while vehicle companies like GM and Mercedes-Benz are drastically increasing their range of car display screens and entertainment functions.

Samsung Electronics' affiliate Harman released its Digital Cockpit 2021. LG Electronics will partner with Magna (powertrains) and Luxoft (car infotainment) as part of a joint venture to enter the electric car market in full force. Mercedes-Benz introduced a next-generation MBUX hyper screen, which is 30 inches wide with a curved screen, for car use and AI-based infotainment functions.

AI-based smart ecosystems within cars are expected to develop faster than in smart homes for several reasons. One reason is that consumers change their cars more frequently than they change their homes and cars have a shorter product lifespan than homes. Another is that cars have limited space and contain various electronic goods within a small area. In the near future, the increase in manufacturing of electric cars and the connectivity of such cars will result in the release of diverse, car-exclusive smart appliances.

▣ Innovation of Everyday Spaces and Products

There is IT innovation for products in the following areas: performance improvement, added designs and functions, form factor innovation, and the merging of AI services and content. In the robotics and automobile sectors, expectations are high for the commercialization of future products.

Robotics

The introduction of AI service robots is expected to result in robots being present in a wide range of everyday spaces. Samsung Electronics unveiled an AI robot (Samsung BotTM Handy) with movable arms that can recognize objects. LG Electronics introduced CLOi, a brand of robot products that help people in diverse commercial spaces.

Automobile

Self-driving cars, which have interior spaces that are similar to living rooms, and vertical takeoff vehicles such as manned drones will create new mobility platforms and accelerate the convergence of cars and home appliances. GM unveiled two new

concept designs: 1) the Cadillac Halo, a self-driving concept passenger vehicle with a living room-like interior and 2) the VTOL, a flying car with vertical takeoff and landing abilities.

▣ Emergence of Remote Healthcare and Digital Health+X Based on Growing Interest in Sanitation/Health Issues

Due to the widespread transmission of COVID-19, new personal products that combine sanitation and sterilization with virus-blocking technologies have been developed. These new products suggest that the market will experience significant future changes.

Large foreign companies, such as Carl Zeiss and ACCO Brands, featured personal sanitation devices as their key products. Korean company Pakers unveiled a sensor detection-style "sanitation box" for everyday items that opens and closes automatically. Korean conglomerate LG Electronics unveiled a sanitizing and sterilizing robot that incorporates self-driving techniques and contactless quarantining technologies to keep sanitation workers safe even in places with large floating populations.

Additionally, there were many products and services that combine facial recognition and virtual reality (VR) in wearable devices, contactless beauty, and healthcare industries. There is now an expansion of products in the digital healthcare sector based on converged technologies. It is noteworthy that the Best of Innovation Award was given to a product that combines VR and data analysis technologies with healthcare.

A variety of products featured AI technologies. Korean company M2S received the Best of Innovation Award for VROR EYE Dr, an eye health solution that uses AI to provide 10 ophthalmological diagnostic and care services. Dental product manufacturers featured AI toothbrushes that can be programmed to individual needs. One remarkable area was teledentistry, a contactless form of dental care that connects dentists with patients, registers patients, and provides diagnostic and curative care.

CES 2021 also featured diverse devices and systems that were designed to supplement remote healthcare. OMRON Healthcare (Japan) unveiled Vital Site, a system that remotely monitors hypertension patients. HD Medical (USA) unveiled the HealthyU, an all-in-one remote patient monitoring device.

A few Korean companies and startups received Innovation Awards for remote healthcare. LG Electronics featured robots equipped with sanitation and sterilizing technologies, while ATsens unveiled a long-term ECG (electrocardiography) measuring technology in a wearable device (AT Patch). Korean products, however, focused mostly on wellness and beauty.

3. Korea's Report Card for CES 2021

Fewer products were nominated for the CES 2021 Innovation Award compared with the year prior due to the decrease in the number of participating companies at the event. There were 464 products nominated in 2020 and 386 in 2021.

The category that received the largest number of Innovation Awards was Health & Wellness (45). This was largely due to a change in consumption trends caused by COVID-19 and a heightened focus on environmental conservation. The second and third most-presented categories were Smart Homes (33) and Computer Hardware & Components (33). This was followed by: Computer Peripherals & Accessories (28), Headphones & Personal Audio (26), and Sustainability, Eco-Design & Smart Energy (22).

Table 2. No. of products (by country) that received Best of Innovation Award at CES 2021

	US	Korea	Japan	Israel	UK	Canada	Total
No. of Award-winning products (%)	14 (51.8)	7 (25.9)	2 (7.4)	2 (7.4)	1 (3.7)	1 (3.7)	27
No. of Award-winning Companies	13	3	2	2	1	1	22

Source: created by KIET based on CES 2021 website

Note: If Harman (Samsung Electronics affiliate) is classified as a Korean company, USA: 13, Korea: 8.

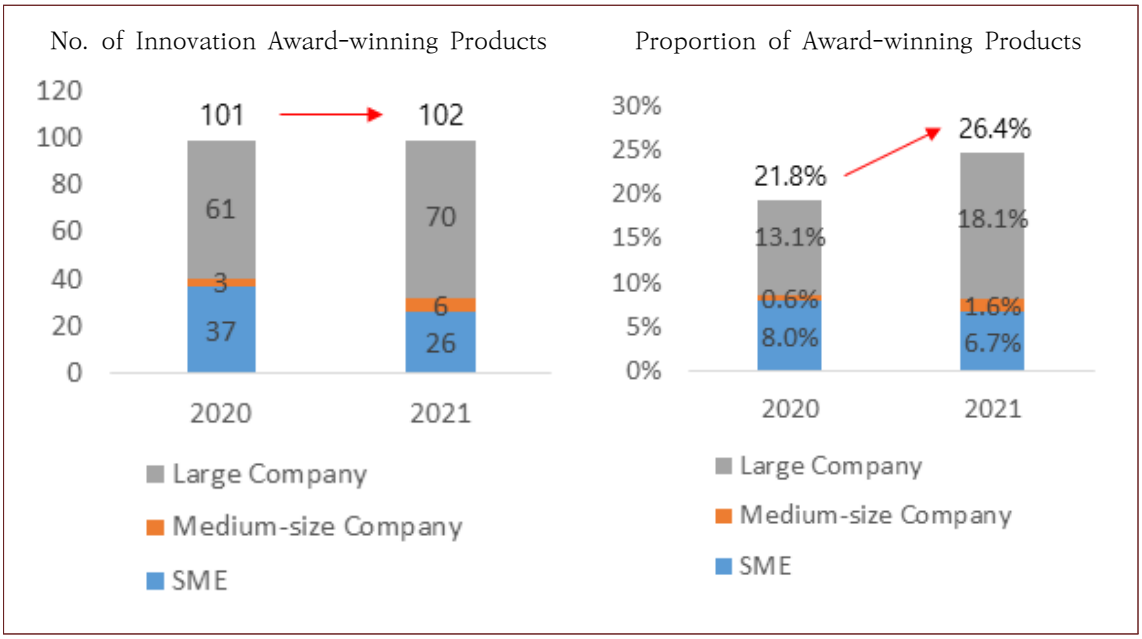
American and Korean products received the most Best of Innovation Awards. One noteworthy product that also received this award was a smart device in the Accessibility category that addresses the needs of the socially disadvantaged. Israel's Voiceitt, which was named Innovation Awards Honoree in the Accessibility category, is a solution that helps those with physical disabilities use smart devices.

▣ Korea Produced More Innovation Outcomes than in 2020 and is at the Forefront of Industrial Trends [4)]

Despite the fact that the number of participating Korean companies decreased, Korea received the same total number of Innovation Awards (102) as last year. Of these, seven received a Best of Innovation Award, proving that the quality of Korea's innovation and products is internationally recognized.

Korean products accounted for 26.4 percent of the total number of Innovation Awards given — an increase from 21.8 percent in 2020. The United States received the second highest number of awards. Samsung Electronics (TV, semi-conductors, mobile) and LG Electronics (TV, daily appliances, electronic mask) achieved an unrivaled level of award output, receiving 44 and 24 Innovation Awards (and four and two Best of Innovation Awards), respectively. Among SMEs, M2S received a Best of Innovation Award in the Health & Wellness category for VROR EYE DR, a VR-based vision diagnosis product.

Figure 1. Status of Innovation Award-winning Products by Company Size



Source: KIET's revision of a table published by the Korea International Trade Association (January 26, 2021).

▣ Innovative Outcomes by SMEs Relatively Low

The number of Innovation Awards received by large companies increased compared to

4) KIET revision of "CES 2021 spotlights 'digital transformation for the everyday' as the innovation trend for the pandemic era," KITA (2021.1.26). There may be errors in some figures due to duplicate counting.

2020. This figure, however, decreased for SMEs, suggesting a relative dearth of innovative outcomes.

The number of Innovation Awards received by large companies was 70 (2020: 61) while the number of Innovation Awards received by SMEs was 26 (2020: 37). The highest-performing category was Health & Wellness (14 Innovation Awards). 10 of these were given to SMEs.

Furthermore, medium-sized companies (companies that are not large but are nonetheless strong and promising) received a relatively small number of Innovation Awards. It should be noted that products from a wide range of categories received awards, suggesting that medium-sized companies are making progress in terms of responding to digital transformation-related trends.

Amorepacific received two Innovation Awards for devices that can produce on-the-spot, individually tailored toners and lip products. Coway's Home Care Dress Care System (a clothing cleaner that is also designed to be aesthetically pleasing), Bodyfriend (a smart massage chair), Mando (a cutting-edge driving system), and Naver (AI reading lamp) each received one Innovation Award.[5)]

4. Threats and Weaknesses

In order to expand and achieve digital transformation in future key business areas such as AI, 5G, bio-health, and smart homes, Korea must collect and use the data from CES 2021 and other future CES events.

The global data market is expected to grow drastically due to increased demand for digital, contactless, and online services. Korea's data industry is still in the early stages of its development and lags behind competitors in other countries.

Major countries such as the United States are dominating markets through sophisticated AI platforms. Korea, on the other hand, does not yet have sophisticated AI technologies and has a relatively weak foundation in terms of its workforce and entrepreneurship. According to an assessment by the Institute of Information & Communication Technology Planning & Innovation in January 2021, Korea's level of AI technology is 87.4 percent (United States = 100). This figure

5) KIET revision of data published by KITA (Jan. 26, 2021). A medium-sized company is defined, in this paper, as a company with assets of between KRW 500 billion ~ 10 trillion in assets.

is relatively low compared to that of China (91.8 percent) and the EU (91.8 percent).[6]

In terms of big data, Korea ranked 87.6 percent. This is a higher figure than that of the EU (86.0 percent) and Japan (80.4 percent) but lower than that of China (94.6 percent). The attendance rate of Chinese companies at CES 2021 was quite low.[7] However, Chinese companies are going beyond the cost-effectiveness strategy by utilizing catch-up and imitation strategies to proactively — and successfully — transition to smart products and a platform-based business infrastructure.

Through a product portfolio that is similar to Korea's, a high degree of manufacturing competitiveness, and a large domestic market, China currently has the world's second- highest degree of AI competitiveness and sophistication of software platforms. By being the first in the world to commercialize 5G, the core technology of the digital transformation, through independently developed technologies, Korea is a global leader in terms of 5G devices and services. Nevertheless, Korea lags behind major countries, such as the United States, in terms of basic research capabilities and key equipment.

▣ Bio-Health

The global digital health market is expected to increase significantly due to the impact of the COVID-19 pandemic, a market trend clearly visible at CES 2021. The global strategy consulting firm McKinsey predicted that the global digital health market will grow from 350 billion USD in 2019 to 600 billion in 2024. According to The Economist, investments in the bio-health market for the third quarter of 2020 were more than double that of same period for 2019.[8]

Korean contactless healthcare technologies (telehealth) are not developing or proliferating as quickly as they are in other countries due to the obstacles posed by outdated regulations and a lack of (and conflicts posed by) relevant systems and infrastructure.

By passing the Coronavirus Aid, Relief, and Economic Security Act (CARES Act) in March 2020, the U.S. broadened the scope of Medicare (a medical insurance program for seniors)

6) *Survey of Global ICT Levels and an Analysis of Technology Competitiveness,* IITP (Jan. 2021).
7) This was markedly different from what happened at IFA 2020, which was held in Germany in September. The event was attended by many Chinese companies, which introduced multiple new products that were competitive with their Korean counterparts.
8) CB Insights materials re-cited from "The Dawn of Digital Medicine," *The Economist* (Dec. 2, 2020).

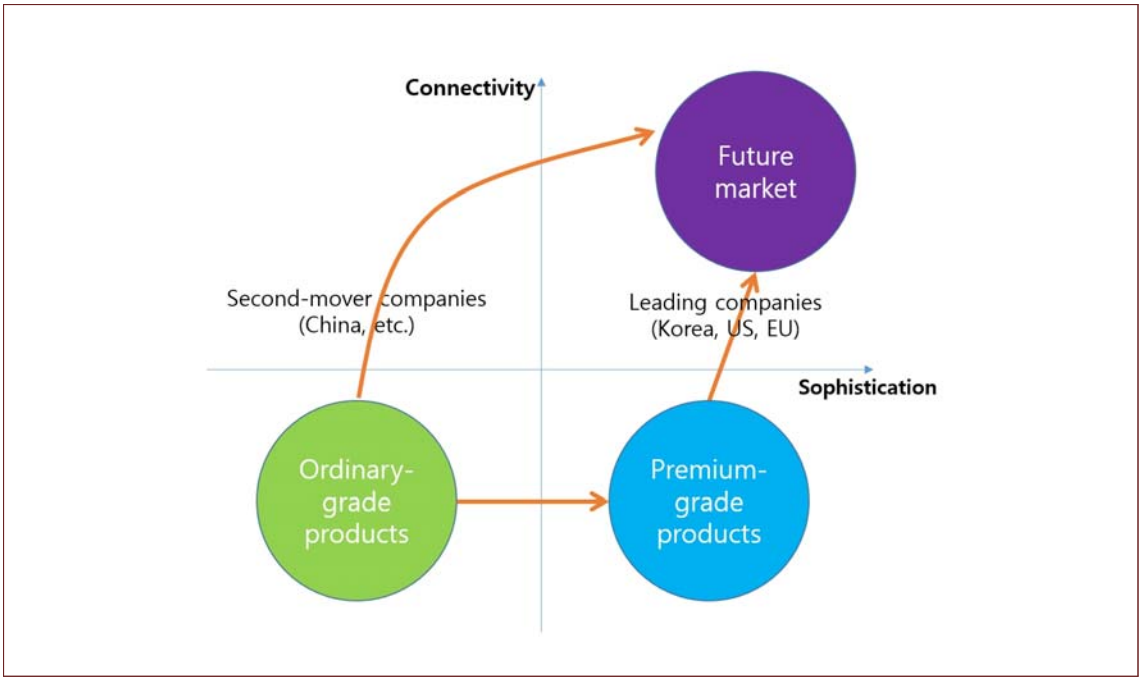
to all areas of remote healthcare. Israel relaxed some regulations on remote healthcare after the outbreak of COVID-19 and is working to accelerate the technological innovation of its digital healthcare startups through subsidies for CES participation.

Korea has permitted phone consultations and prescriptions as temporary measures since February 2020 due to the COVID-19 pandemic. However, Korean medical laws currently do not permit remote healthcare, and the systemic foundations for medical treatment that utilize new technologies such as robotics and VR are quite weak.

5. Tasks Required in the Digital Transformation Era

In the past, the most important qualities of IT products were the functions and services offered per product. Today the sophistication and increased connectivity of IT products and services is drastically expanding the scope of the consumer market.

Figure 2. Anticipated Progression of Changes in the Global Home Appliance Market



Note: Sophistication means improved product performance, while connectivity means strengthened connections (communications) among products and services. These are driving forces that produce new services and added value.[9)]

9) Example of sophistication strategy (TV): LED→QLED→QLED+mini-LED→OLED→micro-LED. Example of strengthened connectivity: The Chamberlain's myQ Pet Portal (addition of pet service to home entrance monitoring system), Moen Incorporated's kitchen faucet (linked to smart home).

Leading companies are at the “premium product” stage and ready to move beyond sophistication (individualization) to create smart home ecosystems via expanded connectivity. Second-mover companies focus on expanding the added value and scope of services by strengthening the connectivity of “regular” products.

Prominent home appliance brands in the EU and Korea are adding multiple functions to their premium products including video and sound, voice recognition, sensors, and sterilization abilities. They are also working to provide more services such as remote controls, shopping, and cooking through strengthened product and service connectivity. Of note, Xiaomi is pursuing an expanded connectivity strategy for regular products by broadening the IoT environment for diverse electronic products as opposed to sophistication.

▣ Korea Must Secure a Unique Competitive Edge Over Major Countries

The universal application of AI is increasingly pointing to the need for innovation from a new strategic standpoint rather than the success techniques of traditional key industries. Korea needs to make bold investments to secure technology and personnel-related capabilities in new or converged technology sectors such as AI, data, and 5G. Korean companies also need to actively engage in open innovation collaboration with global corporations to create synergies and address areas of weakness.

To supplement weaknesses in new industries, Korea needs to strengthen collaborations with leading countries such as the U.S. and China. Korea should also actively pursue M&As with specialized domestic and foreign companies and startups. One especially urgent priority is the strengthening of strategies and investments in response to contactless digitization. In the mid and long-term, Korea needs to move beyond this stage to engage constantly in innovative endeavors and make preemptive investments in future sectors. China is a horizontal competitor of Korea’s in the manufacturing market, a traditional area of strength for China, and is entering into competition with leading countries that are stronger than Korea in major industrial sectors.

It was difficult to assess through CES 2021 the level of innovation that China has achieved thus far. It is clear, however, that the competition between China and Korea will soon expand beyond traditional industries of strength and into new areas that utilize contactless digital technologies.

▣ Preemptive Securing of Core Technologies Required once International Competition Intensifies in New Industries

In order to accelerate digitization and changes in new industry-related markets and secure higher added value, Korea needs to be proactive about strengthening core next-generation R&D.

Korea needs to secure core technologies for products and services based on converged technologies that are closely linked to future demand. It must also create a support system for the commercialization of such developed technologies. Considering the fact that the source of competitiveness is no longer the product itself but rather things such as platforms that enhance user convenience and high-quality services that satisfy consumer needs, Korea will need a concrete strategy for the cultivation of such platforms.

One strategy is a two-track approach: 1) support programs for the quantitative and qualitative growth of Korean platforms and 2) strengthen capabilities to apply and use foreign platforms

Consistent efforts must be made to improve R&D for Fourth Industrial Revolution technologies including AI, data, edge computing, 6G communications, and next-generation security, as well as core technologies required for the digital transformation.

Systems must be created that link large companies with SMEs and venture firms. This includes the joint development of innovative core products and services by SMEs and venture firms and the companies that need such products and services.

Korea needs to be able to respond preemptively to the demands of new service markets, which will be focused on two key spaces in the market of the future: the home and the car. Programs for developing core technologies for these areas must be significantly expanded. For example, the development of new futuristic products such as domestic AI robots and flying cars requires investments from the private sector as well as expanded government aid.

All areas related to new future products such as materials, software, and production processes must be innovated significantly. Since the market is never entirely predictable, R&D must be supported by public subsidies. Government intervention is also required for the revision of related systems and regulations.

With the universalization of contactless media, most experts predict that sanitation and sterilization-related industries will be revitalized. This, in turn, suggests the necessity of preemptive and increased investment to establish dominance in the contactless healthcare market.

▣ Establishment of an Industrial Environment that is Conducive to Digital Transformation

The Korean government needs to aid in the establishment of an efficient industrial environment that responds to changes in the industrial paradigm, including the contactless media and digitization fields, in a timely manner. The Korean government must work to secure foundations for growth and cultivate new industries.

A selection and concentration strategy should be developed that takes into consideration Korea's potential in "second comer" areas of future industries such as materials, parts, equipment, and software as well as current strengths and weaknesses. Support must be provided and collaborative systems created to accommodate SMEs and venture firms in these areas to create a virtuous cycle ecosystem that guarantees the shared growth of materials, products, equipment, and software.

Boundaries that divided one sector from another are disappearing. Consideration needs to be made on new types of collaboration based not on industries but on target markets and consumers. Entrepreneurship and growth-related factors in new technological and industrial areas such as AI and bio-health must be developed in order to secure an industrial environment that promises future growth.

Efforts must be put forth toward systemic and regulatory reform for the digitization that will ultimately be required to expedite investment and the innovation-based growth of future industries. There need to be standards and interoperability systems put into place that assist with expanding connectivity for areas such as AI-based IT products and digital healthcare. This will require the government to conduct empirical projects with the mid- and long-term in mind..

A government report suggests that regulations on Big data, AI, and smart cities might hamper future development in these industries and therefore such regulations are prime candidates for reform.[10)]

IT products such as smart homes and devices are especially in need of state support because they must meet standards that differ by industry and country as well as by interoperability requirements. New AI-based products and services that are used by individuals, such as home AI robots and AR/VR, need to be regularly updated to reflect concerns regarding personal information, ethical management and safety standards.[11)]

10) *Basic Plan for Reform of Regulations on Emerging Industries, Office for Government Policy Coordination* (Dec. 2020).

11) Recently, Iruda (a personal AI chatbot developed in Korea) was suspended just 20 days after being released due to ethical issues and is currently the subject of a personal information leak lawsuit. This incident shows that the personal information leaks and ethical problems that may occur in relation to personalized services must be approached with caution.

Measures must regularly be taken to ensure that unreasonable regulations regarding the introduction of contactless healthcare and new medical technologies such as gene therapy and the use of robots do not impede research. Considering the increased frequency of bio-health technologies being applied to unrelated sectors, regulations that have a strong likelihood of being redundant must be vetted and, if necessary, removed.

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