Trip Report on the Interdisciplinary Center for Advanced Manufacturing Systems (ICAMS) Team Visit to South Korea

July 7 to July 13, 2024

Contract # W52P1J-20-9-3045-CLIN 4

Submitted by: Dr. Gregory A. Harris, P.E., FMSE

Director, Interdisciplinary Center for Advanced Manufacturing Systems (ICAMS)

Auburn University
Auburn, AL

Visiting Team

Chris Peters, CEO, The Lucrum Group
Dr. Ashley Yarbrough, Assistant Professor, Lipscomb University
Dr. Gregory Purdy, Associate Professor, Auburn University,
Associate Director for Research ICAMS

1. Executive Summary

The South Korean government has not only succeeded in accelerating the country's adoption of smart manufacturing technologies but has also turned the quantitative results of that effort into an economic development engine. A team from Auburn University, funded by the Department of Defense's (DoD) Office of Innovation Capability and Modernization (ICAM), has studied this initiative so that lessons learned could help achieve similar success in the U.S.

At the heart of the South Korean government's success is a highly focused and coordinated program that helps its manufacturing industries generate 26% of the country's Gross Domestic Product (GDP). The Ministry of SMEs (small- and medium-sized enterprises) and Startups is a cabinet-level organization responsible for industry policies and funding. In 2019, the organization created the Korea Smart Manufacturing Office (KOSMO), a department solely focused on manufacturing and responsible for achieving outstanding results.

KOSMO established and defined four "smart manufacturing" levels and set an objective of getting 30,000 of the country's manufacturers to at least a basic level by 2025. Executing this $414 million program, KOSMO surpassed that objective two years early. The program has now advanced to become Midas 2027, where they plan to have 25,000 manufacturers advance to a higher level of digital manufacturing and bring in 5,000 more manufacturers. This effort was bolstered by establishing 19 demonstration centers where manufacturers can see smart technologies in operation to better understand how they may help. Additionally, two fully outfitted Smart Manufacturing Innovation Centers (SMIC) were created, providing modern tools and connectivity to serve as development and test beds for industry engagement. The availability of 600 manufacturing mentors, with another 400 being recruited, further strengthens this effort.

To address workforce needs, South Korea has a well-coordinated and robust effort that begins in high school and continues through advanced degrees. A key requirement is that all those teaching manufacturing must come from manufacturing.

The findings clearly show how South Korea's policies, practices, and investments have quantitatively raised the level of the country's manufacturing. The Auburn team is recommending that the DoD ICAM team follow up with a visit to South Korea to explore these programs in more detail. The DoD ICAM office should also charge the Auburn team with developing recommendations for the U.S. that would leverage these lessons learned.

2. Background

A key element in various Interdisciplinary Center for Advanced Manufacturing Systems (ICAMS) projects, including the longitudinal Smart Manufacturing Adoption Study that began in 2022, has been examining other countries' smart manufacturing adoption efforts. South Korea has consistently accelerated the depth and breadth of smart manufacturing adoption [1].

The ICAMS research team had the opportunity to meet with the South Korean government officials responsible for the industrial digital technology policy, resulting in more than 30,000 manufacturers adopting smart manufacturing technologies out of an estimated 349,000 small and medium-sized manufacturers in South Korea [1]. This is a significantly higher rate of adoption than in other countries. The ICAMS team traveled to meet with the government agencies responsible for the program and visited a demonstration center and several companies participating in the South Korean program. The trip was possible through a previous relationship between Dr. Hyunbo Cho of Pohang University and Chris Peters. Peters had been a guest speaker at an advanced manufacturing conference in Seoul, where he met key individuals responsible for several nationwide manufacturing initiatives. He then brought Dr. Cho and members of the Korea Institute of Industrial Technology (KITECH) in for a 2012 meeting with the White House Office of Science and Technology Policy, DoD, DoC, NASA, and others to learn how they were helping South Korean SMEs.

In a follow-up interview with Professor Cho in July 2023, it was learned that Korea had far exceeded its goal of having 30,000 companies achieve a level one or two smart manufacturing rating two years earlier than planned. The program has been so successful that it has shifted from a “smart manufacturing” focus to a “digital manufacturing” focus, requiring an even greater commitment by the country’s manufacturers.

Much of Korea’s success is due to the collaboration of government agencies that share a common goal and deliver consistent messaging to all Korean manufacturers. This government-led effort began with subsidizing the cost of enterprise resource planning software, which is considered a foundation for many advanced manufacturing capabilities. Another key element is that Korea, which is approximately the size of Missouri, has 19 demonstration centers so that companies can easily learn about smart manufacturing technologies without traveling long distances. This is in stark contrast to the U.S., which has less than a handful in the entire country.

One benefit of Korea’s success in driving the adoption of digital manufacturing is that it provides Korea with a powerful economic development tool. Korea advertises globally that

its manufacturers are more competitive having adopted advanced technologies and practices that help them produce quality products faster and at a lower cost.

As the U.S. struggles to get its small- and medium-sized manufacturers to adopt smart manufacturing, many valuable lessons can be learned from Korea's success. Fortunately, the Korean government was willing to share those lessons with the ICAMS team. The government offices that hosted the ICAMS team included organizations under the Ministry of SMEs and Startups (https://www.mss.go.kr/site/eng/main.do), specifically the Korea Technology and Information Promotion Agency for SMEs (https://www.tipa.or.kr/eng/sub011), and the Korea Smart Manufacturing Office (KOSMO) under the Ministry of SMEs and Startups (https://www.smart-factory.kr/)

In addition to meeting with the government team responsible for the Korean success, we visited the $10 million Smart Manufacturing Innovation Center (SMIC) and four manufacturers that have adopted digital manufacturing capabilities and have taken part in the Korean program. Learning firsthand from the manufacturers about their digital manufacturing journey provided great insights as we look to catalyze adoption within the U.S. industrial base.

This was a unique opportunity to gain insights from a valuable U.S. ally that could help the ICAMS team better position domestic manufacturers to become more globally competitive.

3. Overview

Based on primary and secondary research, it is the ICAMS team's belief that South Korea leads all other countries when it comes to providing their manufacturers with the right tools to decrease costs, decrease delivery times, improve quality, and increase profits. In a country with few natural resources like metals or lumber, the Koreans have found other ways to become globally competitive. The country's policies and focus on manufacturing clearly offset the lack of natural resources. Also, Korea has quantified results from its manufacturing programs to market Korean companies worldwide, touting the efficiency and innovation that companies can gain by working with Korean SMEs. In achieving what they termed "Smartification," which refers to the implementation and use of smart technologies in manufacturing, KOSMO helped more than 30,000 manufacturers become smart factories by 2022, achieving significant improvements in productivity (up 29%), quality (up 42%), costs (down 35%), delays (down 18%), sales (up 11%), and industrial accidents (down 1.5%).

4. Findings

I) Government is Highly Focused on Advancing Manufacturing (~26% GDP)

South Korea has The Ministry of SMEs and Start-ups, a cabinet-level organization responsible for manufacturing, especially SMEs and start-ups. This and other subordinate government organizations have developed specific coordinated policies to quantitatively increase manufacturer performance in cost, quality, and delivery performance.

KOSMO, a department within the Ministry of SMEs and Startups, uses a four-phase model to determine the level of smart manufacturing capability: Basic, Intermediate 1, Intermediate 2, and Advanced. The Basic level is defined as the digitization of production information. Intermediate 1 is defined as the real-time collection and analysis of production information. The Intermediate 2 level is defined as the control of the production process through the smart manufacturing system. Advanced is described as customized flexible production, and an intelligent factory.

The Ministry of SMEs and Startups announced the Smart Manufacturing Innovation Strategy in 2018. KOSMO was founded in March 2019 to pursue this policy targeted toward advancing 30,000 manufacturers to a level 1 smart manufacturing capability by 2025. This target was easily surpassed, achieving 30,144 by 2022. South Korea allocated $414 million for this effort, including subsidizing the cost of Manufacturing Execution Systems (MES) by 50%, recognizing that MES software was the foundation of developing a smart factory.

II) The Role of KOSMO

KOSMO has been pivotal in implementing technology adoption projects for SMEs. With a budget of $180 million, KOSMO focuses on infrastructure and the spread of smart manufacturing. KOSMO operates 19 demonstration facilities (Pilot Smart Factory) nationwide, making it easy for SMEs to see technologies firsthand. As identified in the research ICAMS has been performing, seeing technology in action is a key driver in adoption.

Figure 1 KOSMO Offices

Additionally, KOSMO has more than 600 SME coaching mentors and is recruiting 400 more. These are manufacturing retirees who can help SMEs better understand and adopt smart manufacturing. AS identified in the research ICAMS has performed into technology adoption by SMMs, peer acceptance is the number one driver of technology adoption.

KOSMO provides government funding for the Smart Manufacturing Integration Center (SMIC), which operates two facilities for demonstration, education, and research. The first in Gyeonggi-do hosts several hundred companies every month, allowing them to see smart manufacturing technologies first-hand. The second in Changwon focuses more on machining and defense needs. A key factor is that these test beds allow smart manufacturing solutions providers to test and demonstrate their products and services.

III) MIDAS 2027 Policy

Launched in September of 2023, this policy aims to bring 25,000 factories to Level 2 and add 5,000 more to the digital manufacturing program. The focus is on tailored support and developing a manufacturing innovation infrastructure. There are four parts to the MIDAS strategy. The first is to provide tailored support according to corporate capabilities. Next, they will support the creation of a manufacturing data utilization ecosystem. Third, they will work to strengthen the private sector and regional cooperation network. Finally, they will enhance the capabilities of technology supply companies. The tagline for MIDAS 2027 is "Realizing the golden age of manufacturing through manufacturing innovation and digital transformation acceleration." The KOSMO team promotes the policy positions, promising to become a global manufacturing powerhouse centered on manufacturing SMEs and that KOSMO will join them on this journey. (Press Release for MIDAS 2027 is in Appendix).

IV) Leveraging Economic Development and Collaboration

Government and industry collaboration is key to the success South Korea has achieved. KOSMO and other agencies work closely with industry to drive policy and innovation. This collaboration has led to the creation of numerous smart factories and significant improvements in manufacturing metrics. South Korea is expanding its efforts through partnerships with countries like Germany to promote innovation and interoperability of Industrie 4.0 solutions. (Plattform Industrie 4.0 - KOR (plattform-i40.de))

V) Workforce Development Is Highly Planned and Coordinated

Educational Pathways: South Korea has established smart manufacturing paths for high school students, supported by universities. Many universities have opened departments dedicated to smart manufacturing.

Mentorship Programs: By the end of 2024, over 1,000 mentors with extensive manufacturing experience will be in place to help grow workforce capabilities. KOSMO acts as a matchmaker for mentors and mentees.

Training and Upskilling: Companies like INZI Controls and Daedong Door emphasize training their workforce to handle new technologies requiring significant resources. Korea

has manufacturing programs in high schools, community colleges, and universities. Professors teaching manufacturing in community colleges must be manufacturing retirees, ensuring that students learn from someone with experience. In universities, there are an increasing number of majors related to smart manufacturing to help prepare the workforce.

Junior Colleges: South Korea's equivalent of U.S. community colleges is heavily involved in manufacturing workforce development. One unique characteristic is that all professors teaching manufacturing must come from a manufacturing organization.

VI) Korea Leading Effort on Data Standardization and Integration

Standardization Efforts: KOSMO and its partners are now focused on standardizing data collection and integration across manufacturing processes. This includes utilizing and furthering the development of protocols like OPC Unified Architecture (OPC-UA) and formats such as Asset Administration Shell (AAS). To help accelerate standards development in ways that will benefit its industries, South Korea routinely pays academics and subject matter experts to participate in standards development. This is in contrast to the U.S. approach, which typically relies solely on technical volunteers from industry.

Data Phobia: To address reluctance to share data, KOSMO is developing Artificial Intelligence (AI) services and piloting new data-sharing systems to demonstrate the benefits of integrated data.

Digital Transformation: Companies are moving from digitalization to smart factories and ultimately to digital transformation, which involves the application of AI and other advanced technologies for data analysis and decision-making.

5. Recommendations

- Charge the ICAMS team to develop recommendations for the U.S. that would leverage the lessons learned from South Korea and not require policy changes.
- IBAS should lead a team to visit South Korea and go into greater depth, particularly with shipbuilding and defense manufacturing, which is primarily located in the southern part of the country. Expected outcomes include:
    - Quantified results from Korea's government policies that could better inform U.S. government policy decisions.
    - Capture lessons that could help the U.S. accelerate the adoption of smart/digital manufacturing.
    - Initiate opportunities for inter-country collaboration.

6. Conclusion

While the U.S. has many government-funded initiatives to advance **technologies**, such as the manufacturing institutes, South Korea's government is intently focused on raising the **capabilities** of its entire manufacturing industry. The South Korean government has led a targeted effort to create a digitalized industrial base that can compete with any country worldwide. Leveraging the quantitative results of the South Korean effort in national economic development programs has helped the country's industrial base contribute 26% of the GDP.

The U.S. could benefit greatly from the lessons we can learn from a key ally. In addition to helping make the U.S. manufacturing industry more globally competitive, a greater focus on improving manufacturing capabilities helps strengthen our democracy's arsenal.

The DoD ICAM team should follow up with a visit to South Korea to explore the programs of KOSMO and the Ministry of SMEs and Start Ups in more detail. The DoD ICAM office should also charge the Auburn team with developing recommendations for the U.S. that would leverage the lessons learned.

References

[1] Strengthening Korea's Position as a Manufacturing Powerhouse through the Introduction of Smart Factories View Details | Industry Focus | https://www.investkorea.org/ik-en/bbs/i-308/detail.do?ntt_sn=490753

[2] Does the U.S. Lag in Adoption of Smart Manufacturing? | LinkedIn, https://www.linkedin.com/pulse/does-us-lag-adoption-smart-manufacturing-chris-peters/

Appendix A - MIDAS 2027 Press Release

Ministry of SMEs and Startups

Press Release

www.mss.go.kr

Contact	Rachel Minjo Chun Spokesperson for Foreign Media	044-204-7104 rachelmchun@korea.kr
	Yujeong Kim Assistant Director	044-204-7106

The Ministry of SMEs and Startups will nurture 25,000 digital manufacturing companies by 2027 in collaboration with private sectors and regional entities

MSS presents a blueprint for digital transformation in the small and medium-sized manufacturing industry, one of the national agenda, by announcing the 'Manufacturing Innovation and DX Acceleration Strategy.'

The government aims to foster 5,000 advanced companies and encourage digital transformation led by private and regional entities for 20,000 small and medium-sized manufacturing companies. (2023-2027)

MSS will prioritize tailored support according to companies' capabilities, establishing an innovative ecosystem based on manufacturing data and strengthening the capacities of technology suppliers.

Sejong, October 5 - On September 18, at an Emergency Ministerial Meeting on Economic Affairs and Meeting on Export and Investment Promotion presided over by the Deputy Prime Minister for Economic Affairs, the Ministry of SMEs and Startups (MSS) announced the 'Manufacturing Innovation and DX Acceleration Strategy (MIDAS 2027)'. This strategy includes direction for the digital transformation of the small and medium-sized manufacturing industry and the action plan of the Yoon administration.

[Background]

The government has been promoting smart factories since 2014 in response to the digital transformation trend in manufacturing, laying the foundation for the digital transformation of small and medium-sized manufacturing companies.

Government-led support was limited and failed to address manufacturing site needs.

MSS has collaborated with concerned government offices to establish 'MIDAS 2027' based on the achievements and lessons learned from past policy initiatives. This initiative aims to implement the government's national agenda of digitally transforming small and medium-sized manufacturing industries.

[Key Contents of the 'MIDAS 2027']

First, MSS will customize support for digital manufacturing innovation based on businesses' capabilities from beginning to end, breaking from the long-standing government-led uniform support approach.

When SMEs apply for projects to innovate manufacturing, they will receive specialized support based on assessments by private experts, whether it involves creating new models, improving current ones, or laying the foundations for intelligent factories. In addition, MSS will provide thorough post-support management to enhance businesses' core competencies.

The government aims to aid 5,000 businesses by 2027, focusing on promoting advanced factory models. Local governments will also be encouraged to support the creation of initial-stage factories or allow private entities to utilize policy finance to establish 20,000 such factories. This initiative aims to foster 25,000 digital manufacturing innovation companies by 2027 through government, regional, and private sector collaboration.

Specifically, companies with solid capabilities will be fostered as leading models for digital transformation, incorporating AI and digital twin technologies to minimize worker intervention in autonomous factories or through digital collaboration factories among companies within the value chain. The government will assist companies with different levels of digital manufacturing capabilities. Those with moderate capabilities will receive support to become advanced digital manufacturing factories. It will involve the automation of equipment and processes based on manufacturing data. Companies with somewhat limited capabilities will be supported in creating foundational stage factories that meet their specific needs. These factories will include robots, automation equipment, and digitalization of production information. It will help improve the production environment and address labor shortages.

Second, the government will establish a digital manufacturing innovation ecosystem based on the standardization of manufacturing data at the international level.

A Korean-specific manufacturing data standard model will be developed to improve the efficiency of utilizing manufacturing data. Currently, the data is used inconsistently across factories, hindering smooth business collaboration. The upcoming standard model will be designed to comply with the data standards of manufacturing giants like the EU and the US.

Ministry of SMEs and Startups
https://www.mss.go.kr/site/eng

This will enable smoother collaboration and more efficient data usage in the manufacturing industry. Additionally, guidance development, dissemination, and technical support will be provided to equipment manufacturers and technology suppliers to facilitate the adoption of these standards.

Furthermore, by building upon standardized data, the government will promote the realization of a data economy by facilitating smooth data sharing among businesses and processes. This will include operating an online manufacturing data exchange where companies can register, search, and purchase manufacturing data.

Thirdly, the government will establish a sustainable network led by the private sector and local regions.

The government will support digital manufacturing innovation among small and medium-sized manufacturing companies by promoting voluntary collaboration with technology suppliers and large enterprises. A Manufacturing Innovation Portal will be established to facilitate collaboration between demand companies and optimal partners. This portal will allow companies to search for collaboration partners based on factors such as location and technology field and engage in online consultations.

Additionally, the government will encourage large corporations to partner with SMEs to build mutually beneficial factories, enhancing cooperation among them.

Techno Parks (TPs) will be established as a 'hub' to facilitate the digital transformation of local small and medium-sized manufacturing companies. Local governments will have the power to suggest companies that will participate in intelligent factories to be established by the government.

Finally, the government will strengthen technology suppliers' capabilities, another crucial aspect of digital manufacturing innovation. It will also encourage all project participants to adhere to a healthy market order.

Technology suppliers can improve their business capabilities by utilizing the consulting services provided by private experts. Results in building intelligent factories and other relevant information will be made public to promote the market participation of outstanding technology suppliers. Additionally, opportunities to participate in government projects will be expanded for advanced technology suppliers specializing in artificial intelligence, digital twin technology, and similar fields.

Voluntary market monitoring activities led by the industry will be conducted to ensure the

efficient implementation of government projects. An online misconduct reporting center will be established to monitor project expenditure closely. Any company found guilty of misconduct will face strict sanctions such as participation restrictions and expense recovery.

Minister LEE Young stated, "MSS has developed a strategy that leverages the capabilities of relevant ministries to effectively implement the national agenda of digital manufacturing innovation in small and medium-sized manufacturing companies. The ultimate goal is to lead the manufacturing sector into a new era of prosperity." She added, "The government, private sector, and regional entities will collaborate to nurture 25,000 digital manufacturing innovation companies by 2027 to achieve qualitative and quantitative enhancement in intelligent factories."

Ministry of SMEs and Startups
https://www.mss.go.kr/site/eng

Appendix B - Notes on organizations and companies visited

Date: 7/9/24
Organization: Korean Smart Manufacturing Office (KOSMO)
Attendees: Kwanghyun An, President
Lee Chan-Hyong, Head of Office
Ilbin Hong, Researcher
Baek Kyung Min, Head Researcher
Nam, Hyejin, Head Researcher

- Call themselves **"The Bridge for SMEs."**

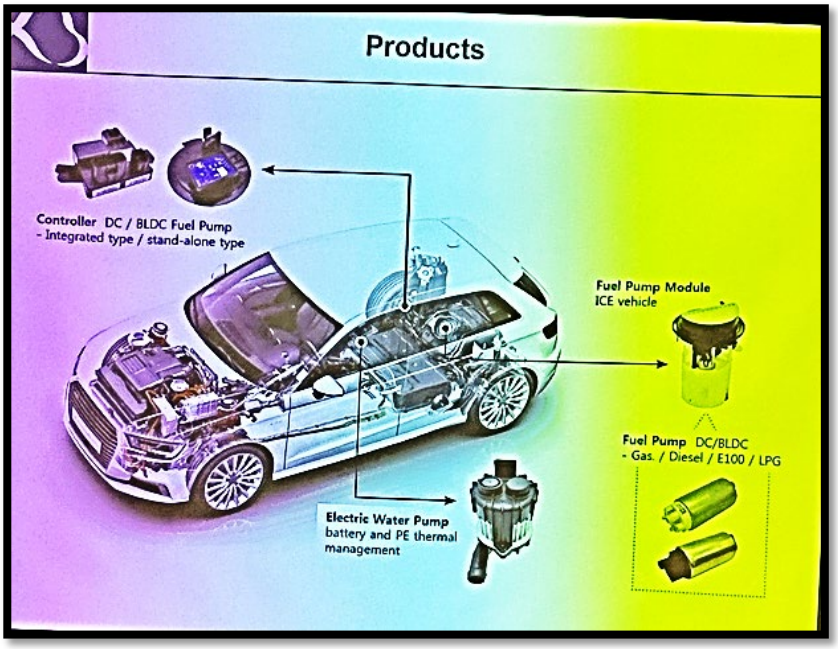
- Korea has a **ministry of SMEs and startups**.
- KOSMO has been around for ~10 years.
- Working to rapidly evolve and standardize data in manufacturing and building the necessary infrastructure to do so.
- 30,144 manufacturing companies were transformed into smart factories from 2014 to 2022.
- There are defined levels for how advanced a company is. It's referred to as a **level diagnosis model**.
- Focus on metrics such as, **production, quality, cost, and delivery**.
- The improvements led to management metrics including employment, sales, and industrial accidents.
- A smart factory is an "intelligent factory" that operates processes using smart technology and is autonomous.
- Their end goal is the autonomous factory.
- There are three categories or steps in a digital transformation: **1. Automation, 2. Intelligent, and 3. Autonomous.**
- They focus on 1. Production management software, 2. Cyber-physical systems, and 3. Analyzing data for factory management.

- The aim is to be able to control production using data. For example- an autonomous system using artificial intelligence (AI).
- They consider **"digitization" to be the lowest level of digital transformation**.
- They stated that "the manufacturing industry is the backbone of [their] economy," which is why they pour resources and effort into it.
- They consider themselves to be ranked 3rd in the world in manufacturing competitiveness.
- Quality will always be a #1 focus.
- **MIDAS 2027** is their new digital manufacturing innovation strategy/policy.
    - They are calling these efforts Smart Manufacturing 2.0.
    - The plan is to have 5,000 advanced factories and 25,000 smart factories.
    - KOSMO helped create the policies. Government helps drive and lead the efforts. Private industry also helps with support.
- KOSMO provides ***customized*** **support** for companies. A key part of this is helping companies **standardize their data**. This requires that KOSMO works closely with information technology (IT) companies.
    - Standardizing data is "fundamental." It includes how the data is pulled/collected, the units, the terminology, its format, its meaning, and more.
- KOSMO has less than 100 employees. They serve the ~349,000 manufacturing SMEs in South Korea.
- Korea is focused on developing the **next generation of workforce**.
    - The number of majors related to smart factories is on the rise.
    - There are smart manufacturing programs in high schools and colleges.
    - In Korean high school and colleges there are a lot of opportunities in smart factory technology and applications.
    - Korea is having a workforce issue due to the low birthrate and retirements which is pushing automation and outsourcing the workforce to other regions.
- They like to be a **"trendy" country**. This applies to everything, including manufacturing.
- They are developing a **mentoring program**.
    - Mentors must have 20+ years of manufacturing experience.
    - Trying to have 1,000 mentors by the end of 2024.
    - They plan to use a matching system for mentors and mentees.
- KOSMO has a huge **data focus**. They try to **decrease "data phobia"** by showing the benefits of AI.
    - They use a give and take method. When they help a company, they have an agreement that the company will provide data and results in return.
- By investing in Korean SME, this provide a value proposition for Korea in two ways:

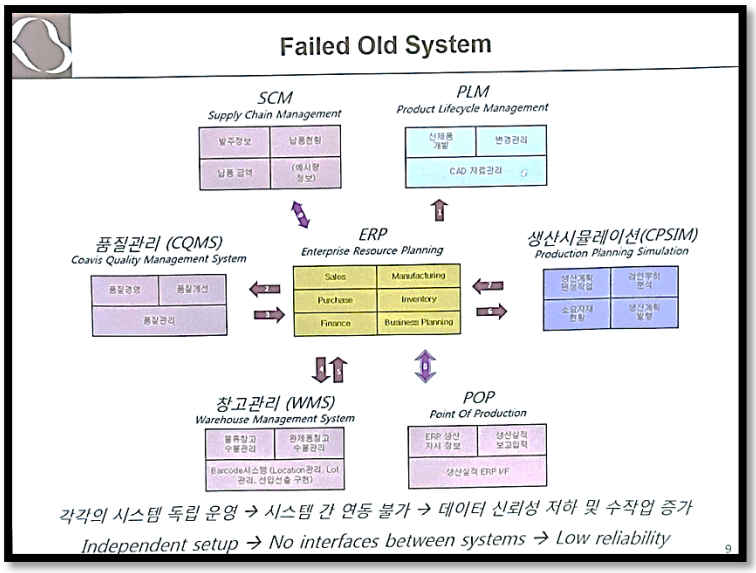
    - (1) Get external organizations to invest in Korea, and (2) provide more capital for Korean companies to invest overseas.
- KOSMO is headquarters of smart factory and many policy initiatives.
- KOSMO requires a data release to be able to do a project.
- Typically, all data is shared and open, or a filtered data approach is used.
    - Delicate border between open and closed data, especially when leveraging AI tools with the data.
    - Data is a major currency of the future.
    - "Dataphobia" is an issue.
    - Companies provide some amount of data to gain access to the AI tools.
    - Data is clustered based on industry.
    - KOSMO's data standardization efforts are starting with equipment and facility data.
    - Korea uses OEE as one of the metrics they track.

Date: 7/9/24
Organization: COAVIS (Large company that manufactures electric pumps for cars)
Attendees: Dongheon Mo, Executive Managing Director

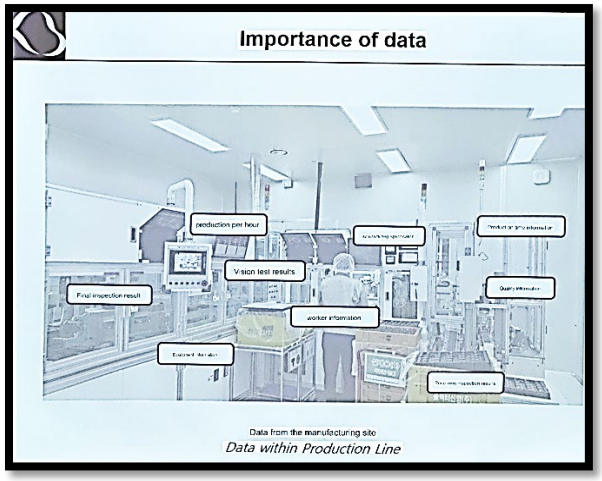
Products COAVIS makes:

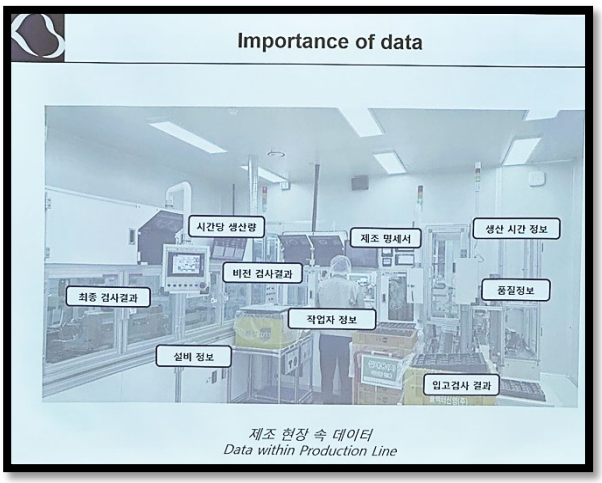


- COAVIS has been thinking about a smart factory since the year 2000.
- Since 2006, they became a global company.
- They supply GM. FPM supplier.
- Won Volkswagen business in 2014 and Ford business in 2018.
- Supply all GM fuel pumps.
- They stress the importance of **standardized master level data**.
- **Failure of the old system** shown in pic:

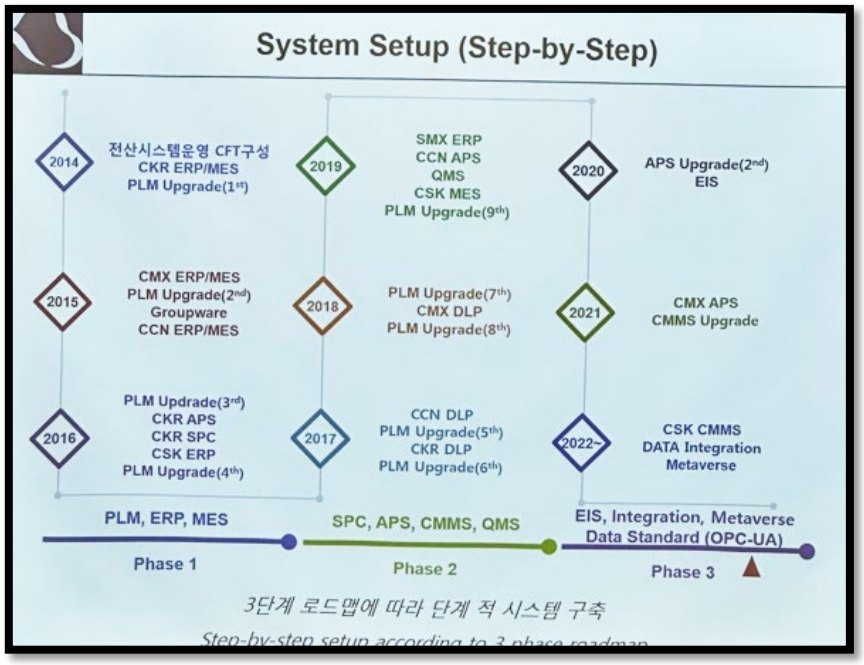


- Note: An independent system causes more costs and issues.
- The first step for a smart factory is **collecting the RIGHT data**.
- Need to specify where the material is located, then know the health and status of the material.

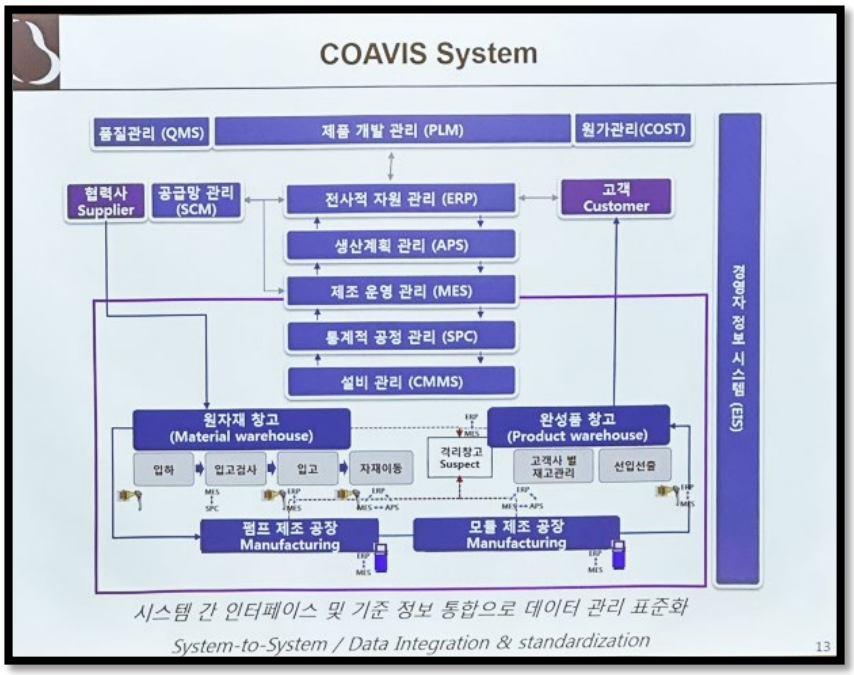




- Data is collected automatically; the worker doesn't have to do anything with the data. The workers shouldn't and can't do their jobs *and* collect data after.
- They came up with the idea of what they wanted to do and outsourced the software development.
- Plant floor software is highly customized. Higher level management software isn't all that customized.



- MES is the pink/purple box below. The benefit is the **transparency**.



- The CMMS, SPC, and APS are the systems actually generating value.
- They thought ERP can do everything. It can't. They began understanding each of the functions in the ERP.
- First stage is making an MES and material tracking system. ERP comes later.
- The customer is the motivation; customers will audit their processes. It's hard to pass the audit without smart systems. You have to be able to answer their questions. They are looking at the quality of the data.
- People get involved in smart manufacturing efforts in waves: a few, then a few more, etc.

Date: 7/10/24
Organization: Smart Manufacturing Innovation Center (SMIC)
Korea Electronics Technology Institute (KETI)
Attendees: Seungwook Nam, KETI

- They have two centers. One is located in Changwon- the military applications facility.
- They focus on transforming smart factories (with automation and IT) into intelligent autonomous factories (with machine intelligence, connectivity, and AI).
- 1. Process, 2. Quality, 3. Inspection, and 4. Safety
- They spread how to use AI in manufacturing.
- Standardization is key.
    - AAS/OPC-UA/KS X 9101 (Smart Connected Manufacturing Standard)

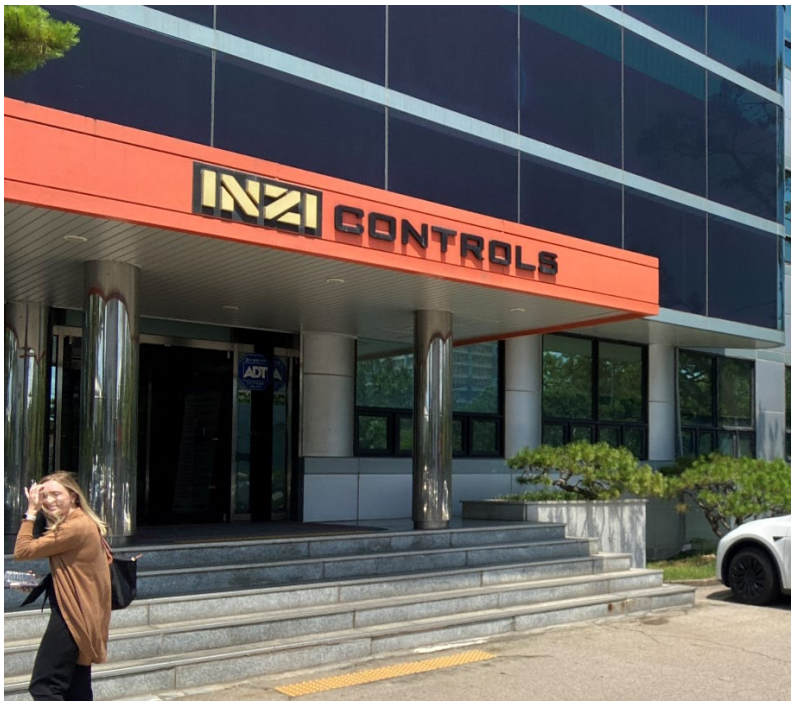
- The facility is a showcase for autonomous and smart manufacturing technologies.
    - This aligns with the policy thrust around autonomous manufacturing.

- The building is called a digital transformation hub.
    - Upper floors provide space for industry to have offices.
- Each SMIC is different from a capability perspective.
- The major keyword they focus on is moving from smart factories to intelligent autonomous factories.
- AI systems are a major focus, emphasizing use for process, quality, inspection, and safety applications.
- SMIC incorporates major international standards, including AAS/OPC-UA/KSX 9101
- A significant challenge they are working through is effectively attaining the data from their systems.
- The facility features a dedicated server room with approximately eight filled server racks.

Date: 7/10/24
Organizations: INZI Controls
Attendees: Director of Smart Manufacturing Globally

- They have a location in Alabama.
- 6 factories are in Korea
- Steps: 1. Define data collection criteria, 2. Data consistency verification, 3. Integrated platform implementation
- Their roadmap aimed to standardize the data they collect.
- Have MES, SPC, and QMS integrated with legacy systems.
- INZI used government funding to create a big data platform.
- They use the OPC-UA standard that SMIC mentioned.
- They use a relational database management system (RDBMS)
- Steps: 1. Data collection, 2. Data storage and processing, and 3. Data analysis
- When asked why transform? The response was “to survive.”

- They choose to implement these systems out of pride, not customer requirements.



Date: 7/10/24
Organizations: Daedong Door, Subsidiary of Hi-Lex
Attendees Seungchul Song, Vice President
Heejun Park, Production Division Director

- Total revenue for Daedong Door is about $300M, and the total for both Daedong Door and Hi-Lex is $500M.
- Their priorities are 1. Automation, 2. Electrification, and 3. Integration
- A major challenge they identified for placing facilities abroad is a lack of skilled workers.
- Inflation and labor costs are forcing them to automate
- Customers require improvements also
- They make door systems, door components, and power liftgate systems.
- 10 plants in 5 countries; one is near the Georgia KIA plant
- They supply KIA, Hyundai, and a few others but in much smaller percentages.
- Have ~8 products.
- Data architecture is ECM, TQMS, SCM, SOPHOS, MES, and PLM all communicating with the ERP.
    - This architecture is similar to the failed architecture identified at COAVIS.
- Data management is difficult. They have had issues with wrong data inputs. They've realized this has a cascading effect because there are many connected systems.
- They are not sure what data is most important yet. They are currently focusing on collecting data and figuring out how it can be used for improvements.
- This plant is considered a Level 3, and they believe there is a big gap to reach Level 4.
- Many employees don't understand or see how data collection can be advantageous.
- Some improvements are for marketing- to show off to customers.

- They have a tight investment budget. They have used their own budget for automation. They use government funding for IT. They have 2 IT employees.
- Their main motivation for becoming a smart factory is profit. The decreased birth create will play a role in the future and cause a stronger need for automation.
- Korea learned a lot from Japan in the past. They stated that it seems that Japan hasn't automated as much because they value people more than machines.
- They are working hard to get accurate data. They are collecting data and unsure of what to use it for.
- Workers think data is the job of managers. They need to make data entry as simple/mistake-proof as possible.
- They stated that rural areas have a harder time getting a workforce.
- Cyber attacks have been an issue.
- They do not see the value in the investment necessary to move up to a Level 4 smart factory.

Date: 7/11/24
Organizations: LS Electric
Attendees: (Host did not provide a card)

- They are developing an innovation center which will be opening soon.
- They transformed because they "needed to." They transformed in a **modularized fashion**. They are working on combining everything to work as a whole.
- There are two factories. This location is low volume, high mix production. The other factory does high volume, low mix production.
- They want to reduce human error (one of the goals of a smart factory).

  - 1 operator on the plant floor may make 100 different products, so he needs help from the smart factory system.

- The robots can handle ~50 different products.

- They have a lot of workers from Southeast Asia.
- They try to make the non-visible, visible. Then, they figure out what can be done with the data analysis.

- All manufacturing steps are recorded and turned into data (ex. can see how long each step takes).

- A major challenge they identified is getting their systems to integrate with one another, Their smart workbench has built in controls to reduce the number of errors.
- The Smart workbench is key for foreign labor to standardize processes.
- Smart workbench also allows for robust data collection that would not be possible with just a camera.

Date: 7/11/24
Organizations: ChongKunDang Pharmaceuticals
Attendees: Ju-Young Hwang, Director, Engineering and Maintenance
Yong-San Choi, Team Manager, Engineering Team

- Went from data collection by operation to aggregating the data into one data warehouse.
- "Virtualization"- one of the objectives is to be able to use a remote control to control the process.
- They are creating a metaverse to remove human interaction from medicine production.

- They showed a system roadmap which includes both IT and OT considerations.
- Metaverse factory relies on significant amounts of historical and real time data connections.
- In 2019, they installed a room environment monitoring system (REMS), which can be controlled through a remote tablet interface.
    - This type of system provides much of the real time data used in the metaverse factory.
    - Another system providing data is the factory energy management system (FEMS).

- The Metaverse helps to reduce the number of human interactions during the creation of the products.
- The metaverse factory has helped to reduce cross contamination.
    - Both 3D and AR modes are available with the ability to remote access the HMI on the shop floor.
- Took about one year for the interface to be developed.
    - The infrastructure and embedded systems have been in development for five years.
- A company consortium led the development of the metaverse factory.
- Steps: 1. Connectivity, 2. Digitalization (Industry 4.0), and 3. Intelligence
- Real-time data collection, analysis, and control of manufacturing // inspection // quality // equipment // energy // storage // supply
- Securing a competitive advantage system in quality and productivity.
- They've created a virtual factory that can control the actual machines.
    - It shows real-time production data.
    - They hope to use AI to predict optimal values for the machine settings.
    - It took 5 years to build the infrastructure and 1 year to build the metaverse (the art part or the user interface (UI))