

A Traffic Control Center in a Semiconductor Factory? Simulation-Based P&S (Planning & Scheduling) System Development for Smart Fab Production Management

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On city roads during morning and evening rush hour, serious traffic jams can arise if the traffic light controllers do not function properly. The same situation can be envisioned in factories that produce semiconductors through complex processes. In this regard, factories also need traffic control centers. The simulation-based P&S system developed by KAIST acts as an intelligent traffic control center that helps prevent production line congestion.

Semiconductors are small in size but are an integration of all types of cutting-edge technology. Due to the high level of technology and complex processes involved, the structure of a semiconductor factory is also very complex, consisting of about a thousand processing steps. In the production line of a semiconductor factory, there are complex intersections, much like that of busy roads in large cities. When traffic increases, roads become congested and a bottleneck effect occurs, making it difficult to manage intersections. Likewise, in factories, it becomes difficult to manage the entire 'flow' as production rates increase. In order to operate a factory efficiently, as many products as possible must be produced under a given amount of time. Therefore, the management of such congested production lines is an important issue to consider.

If the production line of a factory is similar to a road, then the operation system of road traffic can directly be applied. Large cities such as Seoul and New York utilize intelligent traffic control centers to control urban traffic levels. A good example of this is traffic light control. In a crowded city, green lights are prolonged in directions of rush hour traffic, whereas the time for each green light is reduced on roads with less traffic in order to maintain the traffic flow regardless of the amount of traffic.

Semiconductor factories have led the IT industry in Korea. Professor Byoung Kyu Choi and his research team have developed the P&S system, which acts as a "traffic control system" that allows efficient operation management of high-tech factories.



Samsung Electronics

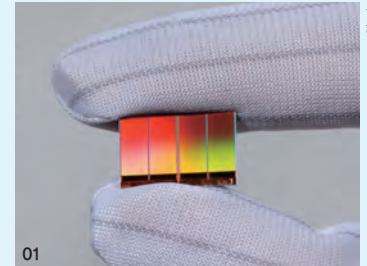
P&S System: The Traffic Police of a Complex Production Line

Similarly, a system that manages production rates in semiconductor factories is needed. At Professor Byoung Kyu Choi's lab in the Department of Industrial and Systems Engineering, researchers are investigating a simulation - based planning and scheduling (P&S) system. The P&S system simulates the production process of a factory and creates a factory management plan for a high amount of production in the least time. The P&S system detects equipment that possesses the risk of congestion and evenly distributes production flow in order to prevent a bottleneck effect and maintain a smooth production flow. Professor Choi, who is part of the National Research Laboratory Program of Korea, developed this technology and has transferred this technology to VMS Solutions, Inc., a spin - off venture firm. Furthermore, Professor Choi is developing a more advanced system in collaboration with Samsung Electronics.

After the technology of the simulation - based P&S system was transferred to VMS Solutions, Inc., collaborative research enabled the development of a software system known as SeePlanAPR®. Samsung Electronics Company currently incorporates SeePlanAPR® in the operation management of all of their semiconductor and LCD factories. In late 2011, Samsung Electronics implemented SeePlanAPR® as a standard solution and is expanding the system to the area of factory planning. Based on the success of SeePlanAPR®, VMS Solutions, Inc. has increased their employee number from five to 30 and has gained recognition as a higher value - added technology venture firm. Because the high - tech components industry depends on the rapid development of new products and mass production with stability, this research development is expected to enable domestic firms to surpass firms in advanced countries.

Implications and Future Prospects

The success of the simulation - based P&S system has two implications. First, this system provides a solution for efficient operation management of the production of high - tech components, which plays a key role in domestic industry. Second, this study gave birth to a higher value - added technology venture firm that provides solutions based on purely domestic technology in today's vulnerable domestic software industry. SeePlanAPR® has contributed to higher competitiveness of domestic firms such as Samsung Electronics and others that have deployed simulation - based factory operation management systems so that they may better compete with overseas competitors. Furthermore, the wide expansion of diverse application systems that utilize this technology is anticipated to reach foreign markets as well. In terms of foreign market expansion, Samsung Electronics is using this technology in their production lines in the U.S. and China, as is Hankook Tire in their production factory in Hungary.



01 It may look small and simple, but producing a semiconductor requires a complex yet intricate and elaborate process.

02 The unit cost of semiconductors greatly affects the industry as a whole. This is because most sectors of industry require semiconductors from IT devices to vehicle and construction control systems.

● **Research Funding** | A total of 34 simulation - based P&S system projects were conducted with manufacturing firms such as Hyundai, Samsung Electro - Mechanics, Samsung Electronics, and LG Display and government agencies such as the Ministry of Science and Technology and Small and Medium Business Administration ● **Awards** | The Technology Innovation Award from KAIST in 2012 and 'the Korea Engineering Award' awarded by the President of Korea via the Ministry of Education, Science and Technology in 2009