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A Study on Competitiveness Improvement and Countermeasure of Export Promotion in Korean Industry*

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Abstract

Purpose: The plant industry is a key order-taking industry that leads national industrial development through convergence and integration with various industries in all value chains from planning and marketing to financing, design and engineering, purchasing, construction, and operation and maintenance (O&M). **Research design, data and methodology:** The Korea government has been actively promoting overseas plant market development support projects to support large and public enterprises and medium and small enterprises. **Results:** The Korea government are working with the industry and the government so that the Korean plant industry can establish itself as a key driving force that provides the foundation for low-carbon and energy transition that our times demand and makes our world a better place to live. **Conclusion:** A high value-added industry that brings enormous profits and international fame to exporting countries. Korea is highly dependent on trade, should recognize the plant industry as a key national export sector.

Keywords: Competitiveness, Plant market, Plant industry, Integration

JEL Classification Code: M10, M31.

1. Introduction

The plant industry is an industry that creates added value through a series of industrial activities related to plant construction. It can be said to be a comprehensive system that creates tangible and intangible goods through activities and project management such as engineering, purchasing, construction, maintenance, and repair. The plant industry is largely divided into oil/gas, environment/freshwater, power generation, petrochemicals, industrial facilities, etc.

The plant industry is a representative convergence/composite industry that combines manufacturing and services. It is characterized by the large-scale business scale and advanced engineering capabilities

required, and the need to support everything from financing to operation/maintenance (O&M), marketing, and other services. In particular, it has a wide range of complex value chains, so there are many opportunities for players to participate, and it is advantageous for creating added value, and it can contribute to increasing demand industry production and upgrading industrial structures through ripple effects.

In addition, it led domestic exports until new IT industries such as semiconductors and displays emerged, and it has shown meaningful results by recording orders worth more than \$24 billion per year over the past three years from 2020 to 2022, despite the downward trend in orders due to COVID-19. Korea began participating in

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overseas plant orders in the 1990s, and the government set a goal of receiving \$30 billion in overseas plant orders last year.

2. Research Background and Concept

Plant refers to industrial infrastructure such as power generation, desalination, oil refining, petrochemicals, crude oil gas treatment, marine facilities, environmental facilities, etc., and production facilities or factories as a comprehensive unit of industrial machinery, machine tools, and electric and communication machinery (Rajah, 2020).

The amount of overseas plant orders refers to the amount of orders received by domestic companies from overseas orderers and the amount including the performance of exporting plant equipment to overseas plant projects.

Even if a domestic company receives an overseas plant order, the overseas plant order does not necessarily mean export performance due to foreign local labor costs, use of foreign plant equipment, foreign service and engineering projects, and delivery of domestic equipment to foreign ordering companies.

The amount of orders is shown as the total amount by year and the performance up to the month of the year, and is also classified by major region to enable understanding of trends.

2.1. Economic Effects of Plant Orders

Plant orders are a complex industry that involves detailed design (E), purchasing (P), and construction (C), and have high industrial linkage effects and contribute to the advancement of industrial structure.

Table 1: Each Industrial Effect

	Agricultural, forestry and fishery products	electrical & electronic	Construction, Finance & Insurance	Finance & Insurance	Plant
Forward association effect	1.03	1.08	0.56	1.32	1.25
Backward association effect	0.77	1.25	0.97	0.65	1.18

Source: Ministry of Trade, Industry and Energy 2024

Plant orders lead to expansion of follow-up machinery exports, promoting overseas expansion of small and medium-sized equipment companies. General machinery exports are also increasing as overseas plant orders increase.

Belows are Index Interpretation as follows,

Here is analysis of overseas plant order trends and '23 overseas plant order amount increased by about 25% from

the previous year's 24.18 billion dollars to 30.23 billion dollars

This is the highest performance in 8 years since 2015 (36.47 billion dollars)

Additionally, there are order trends by region

First, (Middle East: 11.42 billion dollars) Orders for mega projects centered on oil & gas and petrochemicals in Saudi Arabia

For example 1, Saudi Amiral Petrochemical Plant (5.08 billion dollars, Hyundai Engineering & Construction), example 2 is Saudi Jafurah Gas Plant PKG2 (2.37 billion dollars, Hyundai Engineering & Construction-Hyundai Engineering JV)

Second, (America: 10.14 billion dollars) Localization of domestic companies' production to respond to the US Inflation Reduction Act (IRA) and the company's corporation becomes the orderer and leads to orders for domestic EPC companies

For example 1 is LG Battery Plant in Georgia, USA (1.2 billion dollars, Hyundai Engineering) and example 2 is SK Battery Plant in Georgia, USA (1.75 billion dollars, Hyundai Engineering)

Since this is a compilation and organization of overseas plant project orders from members of the Korea Plant Industry Association, small-scale projects from non-members may have been omitted.

Generally, the plant refers to industrial infrastructure facilities such as power generation, desalination, oil refining, petrochemicals, crude oil/gas treatment, marine facilities, and environmental facilities based on <Table 1>, as well as production facilities or factories as a comprehensive unit of industrial machinery, machine tools, and electric and communication equipment.

2.2. Definition of plant export

2.2.1. General definition

Plant export generally refers to the comprehensive export of a production unit that combines hardware such as machinery and equipment required for manufacturing and processing various products and software such as engineering, know-how, and construction required for their installation. Plant export is classified into export of only industrial facilities and export by turnkey method. Turnkey method is export that includes not only industrial facilities but also technical services and construction.

2.2.2. Legal definition

Korea systematically defines and classifies plant export through the Foreign Trade Act, the Enforcement Decree of the Foreign Trade Act, and the Foreign Trade Management Regulations. In the past, Korea expanded the use of the

original word “plant” to refer to industrial facilities, and through the partial revision of the Foreign Trade Act, the term “industrial facility export” was changed to “plant export,” and the title of the article was changed from “approval of industrial facility export, etc.” to “promotion of plant export, etc.” According to Article 32, Paragraph 1, Subparagraph of the Foreign Trade Act of our country, plant export refers to the export of industrial facilities of a certain scale or larger as determined by the Minister of Trade, Industry and Energy among the equipment, devices and facilities prescribed by Presidential Decree installed for the management of agriculture, forestry, fisheries, mining, manufacturing, electricity, gas and water supply, transportation, warehousing and broadcasting and communication businesses as specified in Subparagraph 1, and refers to the export of industrial facilities, technical services and construction comprehensively as specified in Subparagraph 2 (hereinafter referred to as “export by lump-sum order method”).

In addition, “equipment prescribed by Presidential Decree” in Article 32, Paragraph 1, Subparagraph 1 of the Foreign Trade Act refers to the following <Table2>.

Table 2: Equipment prescribed by Presidential Decree

1	Fixed-position transport and loading equipment and fixed-position construction equipment
2	New energy and renewable energy equipment
3	Test and research facilities
4	Power generation facilities
5	Desalination facilities and water treatment facilities
6	Air conditioning facilities
7	Pollution prevention facilities
8	Iron and steel manufacturing facilities and steel structure facilities
9	Refrigeration and refrigeration facilities
10	Storage tanks and storage facilities
11	Oil refining facilities and transmission facilities
12	Petroleum processing facilities and petrochemical facilities
13	Marine facilities and water rescue facilities
14	Other facilities necessary for industrial activities

Source: Ministry of Trade, Industry and Energy 2024

3. Promotion of Plant Export Industry

Plants refer to integrated production facilities (systems) that can produce raw materials, intermediate goods, or final products, and can be broadly categorized into oil & gas, petrochemicals, power generation/desalination,

environment, communications/information, and industrial plants. The plant industry is a complex industry (manufacturing + service industry) that combines engineering, procurement, and construction, and has the characteristics of high contribution to forward and backward industrial linkage effects and added value.

The plant industry is a new export engine with high foreign exchange earnings

Plant exports are the supply of production facilities overseas, and everything from the installation to operation of the production facilities, i.e. the entire factory, is exported. Therefore, as the saying goes, “If you sell the factory, the parts will be sold,” plant exports have the aspect of driving the expansion of related manufacturing and service exports by exporting the production system.

In addition, plant exports bring about facility and technology transfers to importing countries and contribute to industrial development in importing countries, so there is almost no trade friction, while the foreign exchange rate is high, so its importance as a new export engine is highlighted.

3.1. Regional Trends in the Global Plant Market

Looking at the trends by sector of the global plant market from 2015 to 2023, the industrial facilities sector will account for the largest market, at approximately 41.7% of the total market as of 2023. In particular, power generation, desalination, and industrial facility plants directly related to the recently emerging eco-friendliness and smartness are leading the growth, and the average annual growth rate of the global plant market from 2021 to 2023 was 16.5% in the power generation and desalination sector as per <Table 3> and 22.6% in the industrial facility sector. This seems to be due to the increase in demand for power generation plants due to the increase in electricity demand for smartness and digital transformation, and the increase in demand for desalination plants due to the global water shortage, driving the growth of the plant market (Schindler, et al., 2024).

Table 3: Regional Trends in the Global Plant Market

(unit: 100mil US dollar)

2015	2016	2017	2018	2019	2020	2021
10,268	10,239	12,227	12,241	12,034	10,933	12,256
3,440	3,404	3,397	3,517	3,514	3,292	3,356
1,891	1,859	1,869	1,890	1,912	1,457	1,453
2,094	2,064	2,172	2,231	2,210	906	2,563
1,874	1,867	1,995	2,009	2,024	1,922	1,709
1,179	1,178	1,401	1,379	1,328	906	1,081
793	784	771	809	557	415	522
21,538	21,394	23,832	24,075	23,579	19,829	22,940

Source: Ministry of Trade, Industry and Energy 2024.

3.2. Overcome Obstacles in Plant Export Industry

In addition, in December of last year(2023), the Ministry of Strategy and Finance, the Ministry of Trade, Industry and Energy, the Ministry of Construction and Transportation, and the Ministry of Information and Communication jointly prepared the 'Overseas Plant, Construction and Information Infrastructure Participation Expansion Plan' and reported it at the State Council, thereby spurring government support for domestic companies to expand plant exports.

In the short term, the government's support focuses on resolving companies' difficulties, and in the mid- to long-term, it focuses on strengthening domestic companies' order-taking capabilities. The specific details are as follows:

First, The Korean government plan to pursue a regional and business-specific order-taking expansion strategy. Government plan to divide the world into five base regions: the Middle East and Africa, Southeast Asia and China, Southwest Asia, Russia and the Commonwealth of Independent States, and Central and South America, and establish and pursue an active and effective order-taking expansion strategy that suits the characteristics of each region.

Second, The Korean government plan to strengthen financial support, which companies have previously cited as their biggest difficulty. The Korean government plan to strengthen financial support through measures such as increasing the Export-Import Bank's equity capital, expanding credit limits, strengthening support for export SMEs, and improving the system to activate project financing.

In addition, The Korean government plan to promote strengthening insurance support related to resource development and market development, introducing a guarantee system for production fund support, and reducing insurance premiums to activate project financing through the Export Insurance Corporation. Meanwhile, The government plan to work to resolve financial difficulties of domestic companies by establishing a joint support system through strengthening connections between domestic and foreign export credit institutions, and strengthening connections with international financial institutions such as the World Bank (IBRD) and investment banks.

The government plan to actively work to create an environment in which domestic surplus funds can invest in overseas plants, construction, and information infrastructure. To this end, the related inter-governmental departments are discussing promoting the issuance of export-import financing bonds, supporting the issuance of profit-participating bonds, and activating the issuance of asset-backed securities (ABS) related to exports such as overseas plants.

Third, The Korean government plan to focus on improving project development and order-taking capabilities, establishing human resources, technology, and information infrastructure for each execution stage, and strengthening corporate capabilities. In the project development stage, in order to strengthen the developer function of government investment agencies and link overseas resource development with plant orders, a project planning and development organization will be newly established at KEPCO and Korea National Oil Corporation. In addition, the formation of a cooperation committee for joint advancement and information exchange between government investment agencies and related companies is also being promoted.

4. Government Countermeasures to Increase Plant Export

Meanwhile, the government plans to actively support project management, construction, and feasibility studies (F/S) for promising projects through related associations (such as the Plant Industry Association). Government support for expanding project orders for domestic companies will also be strengthened. The existing KOTRA overseas trade center will strengthen order support activities, and the dispatch of a joint public-private order team will be promoted to preempt strategic markets such as BRICS, the Middle East, and South America.

A database on order trends and information related to overseas expansion will be established under the leadership of KOTRA, the Plant Industry Association, and the Overseas Construction Association, and a support center for order support will also be established. Meanwhile, we plan to support domestic companies' order-winning activities through strategic use of the Economic Development Cooperation Fund (EDCF), linkage with knowledge-sharing projects for developing countries, and strengthening diplomatic efforts to ease the requirement for double guarantees.

4.1. Korea-Africa Industrial Cooperation Forum

Ministers, high-ranking government officials, and state-owned enterprise representatives from major ordering countries in Africa, which are emerging as promising plant markets, are invited to the Korea-Africa Industrial Cooperation Forum to discuss mutual cooperation measures and provide support for project bids. The main contents include: 1. Ministers and high-ranking government officials from major ordering countries in Africa present project trends and outlooks by country at the Korea-Africa Industrial Cooperation Forum, 2. Export consultations and

industrial inspections are conducted by invited guests at companies, and 3. Opportunities for building personal networks are provided through welcome lunches.

In order to expand overseas plant orders in the mid- to long-term, it is necessary to secure human competitiveness of companies and accumulate and spread knowledge of design capabilities, technology, and business execution know-how. To this end, the Korean government plans to carry out the plant engineering technology personnel training project currently underway and the plant equipment B2B pilot project without a hitch. In addition, the government plans to prepare and promote an engineering technology development roadmap, technology information, and business guidelines in consultation with related ministries and research institutes in the future. The Korean government also plans to implement overseas vendor registration support, joint purchasing projects for raw materials, and group guarantee and insurance systems to help small and medium-sized companies with growth potential enter the plant market.

Looking back, domestic companies achieved \$10 billion in plant exports since 2000 with a challenging spirit even under difficult circumstances. Due to the impact of the Iraq War and SARS, it is currently at a standstill, but if the government's effective support, companies' accumulated experience, and entrepreneurs' challenging spirit are combined in the future, plant exports are expected to increase again. The government's goal is to achieve plant exports of 20 billion dollars. It is confident that plants will play an important role as a new driving force for national development and exports, and the government will also establish a detailed implementation plan based on the aforementioned policies and carry them out without a hitch.

4.2. Support for Cooperation with Multilateral Development Banks (MDBs)

The Korea Plant Industry Association invites key figures from MDBs and key MDB project stakeholders to hold seminars on MDB project development strategies in order to promote participation in major MDB projects such as the World Bank Group, the Asian Development Bank (ADB), and the Asian Infrastructure Investment and Development Bank (AIIB), thereby enhancing MDB project advancement capabilities. Key contents include: 1. Regularly holding seminars on activating entry into PPP projects using MDBs; 2. Hosting seminars on overseas expansion of the plant industry by inviting the MDB Korean office; and 3. Conducting seminars on activating entry into overseas projects using MDBs.

Therefore, a plant does not simply refer to manufacturing goods, but encompasses related fields from manufacturing to construction as the plant industry, and the export of a

production unit that combines related fields is called plant export.

A country importing a plant can foster new industries in the importing country through technical assistance, etc., promote employment creation, and influence the promotion of exports in that country. On the other hand, a country exporting a plant is paying attention to it as a strategic export method because the trade friction and regulations associated with the export of a plant are less and the foreign exchange gain rate is high.

In the past, our country was in the position of a country receiving technical assistance, but now the Korea is in the position of a country providing technical assistance. Our country's plant industry is an export strategic industry that focuses on overseas markets rather than the domestic market, and it is a high value-added knowledge-intensive industry with a large ripple effect on related industries, and the forward and backward effects of each industry are 2-3 times that of the manufacturing and service industries. Looking at our country's export amount, the plant order amount is higher than the export amount of the main export industry, which shows that the industry has a high proportion of the total industry, and its contribution to exports is also high. As such, plant exports are supporting one axis of our country's main industries. Therefore, the plant industry that the author intends to use in this study will be described with a focus on 'export' rather than 'import'.

4.3. Dispatch of Order Receiving Missions and Market Development Teams

The Korean government is making every effort to secure a foundation for entering the plant industry and expand order receiving opportunities by discovering and selecting key cooperation target countries and strategic entry countries, dispatching plant order receiving missions (market research teams), promoting our company, building networks with key figures in the relevant countries, and discussing ways to participate in projects. The main contents include 1. Consulting on order receiving and collecting order information through visits and interviews with major ordering parties, 2. Strengthening cooperation by hosting local cooperation forums, and 3. Supporting exports by hosting 1:1 business consultation meetings.

4.4. Overseas Project Practical Capacity Enhancement Seminar

The Korean government should aim to enhance the overseas plant project practical capacity of our company practitioners through practical capacity education on financial and claim response methods that are essential when planning and executing overseas plants. The main

contents here are 1. Holding an overseas plant project claim response practical education seminar. 2. Conducting a power purchase agreement (PPA) practical education seminar. 3. Strengthening practical capacity through overseas plant project development capacity enhancement seminars, etc.

4.5. Support for Overseas Plant Market Development

The Korean government supports part of the cost when our companies conduct business feasibility studies or market development studies for the purpose of developing (EPC, facility construction, renovation, etc.) and winning orders for overseas plant projects.

There are plant examples such as support is provided for industrial infrastructure facilities such as power generation, desalination, oil & gas, petrochemicals, marine, cement, iron and steel, transportation, loading and unloading, environment, and other industrial facilities, as well as package facilities installed for production plants and such facilities.

Furthermore, there are specific support contents.

1. [Common] Up to 200 million won per project (75% support for SMEs, 50% support for mid-sized companies)

2. Feasibility study

2.1. Support contents: Direct costs of feasibility study such as market and business environment analysis, technology analysis, economic analysis, and sensitivity analysis

2.2. Support items: Overseas travel expenses, outsourcing service costs required for the study, labor costs (partial)

2.3. Support areas: Plant EPC, process equipment, investment development projects

Process equipment is package equipment that takes charge of some functions of the plant, and when a feasibility study equivalent to a feasibility study is required (over 5 million dollars) and Investment development projects are when a feasibility study is additionally conducted for financing among projects for which Pre F/S has been completed (a feasibility study is conducted for this case)

3. Market development survey

3.1. Support contents: Market and business environment survey, quotation to be submitted to the ordering party, interview with the ordering party for order negotiation

3.2. Support items: Overseas travel expenses, outsourcing service costs required for market survey, labor costs (partial)

3.3. Support areas: Mainly equipment that constitutes part of the plant (EPC projects are also possible)

4. Industrial development plan

This refers to overseas travel expenses, outsourcing service costs required for surveys, and some labor costs required for establishing a master plan (plan for building a power plant in a specific region, development plan for water

supply and sewage facilities, etc.) prior to the feasibility study.

5. Characteristics and Forms of Plant Exports

5.1. Characteristics of Plant Exports

The plant industry is a complex of engineering, procurement, and construction, and knowledge-intensive industries such as consulting and financing are added, so it has a high industrial linkage effect and contributes to the advancement of industrial structure. In addition, it is an industry with the characteristics of manufacturing, construction, and service industries, so it has a high forward and backward linkage effect. Another complex characteristic is that plant export transactions are large-scale and long-term transactions. Plant exports involve large-scale financing and guarantees, and plant export financing and guarantees are monopolized by international commercial banks in advanced countries.

From the perspective of companies, the plant industry shows relatively high profitability for participating companies, and from the perspective of workers, the plant industry provides high-wage jobs. In addition, the center of the labor force is made up of 'people working with knowledge', that is, knowledge workers. By organizing these aspects, the general characteristics of plant exports are as follows.

5.1.1. Turnkey contract method for plant exports

The contract method for plant exports is mainly the turnkey method. The scope of work of a turnkey contract is that the EPC contractor completes the contract object (plant) from design to commissioning and transfers it to the owner as a completed facility. In addition, a turnkey contract is composed of Lump Sum + Date-certain Completion.

Even in the case of a Lump Sum contract, the contract amount is often specified for each major component, and by making this contract, the excess cost (cost overrun) that may occur during the plant construction period can be transferred to the contractor. In addition, if the plant construction is delayed or the raw materials or production efficiency are insufficient, the responsible party (contractor) is clearly responsible, and it is easy to impose compensation.

5.1.2. Use of the Liquidated Damages System

Completion and performance can be guaranteed through the liquidated damages (LDs) system. The contractor's delay in completing construction can affect other contracts of the project company, which can result in increasing the company's losses. The loss due to the delay in completion of construction is compensated by Liquidated Damages. The

size of the Delay LDs should be at a level that compensates for the interest, indirect costs, and penalties for the delay in completion.

The financial institution that has made the loan to the project company hopes that the Delay LDs will be reflected at a level equivalent to the amount of the delay for 6 months. The figure is usually 15-20% of the EPC contract (Keola, 2023).

In addition, the Liquidated Damages (Performance LDs) system is utilized to compensate the owner for the loss incurred due to the performance of the completed plant not reaching the level expected in the design.

For example, if the power plant's power production capacity is not up to the original plan level or if it uses more fuel than designed, thereby reducing the project company's profits, the loss is compensated through Performance LDs.

5.2. Return to a Purchaser-Centered Market

In the past, as the plant market experienced a global boom, the plant market became a supplier-centered market, led by companies. The supplier-centered market caused additional rapid price increases and there was a change in the contract method. Since only a few companies possessed the original technology in the FEED (Front End Engineering & Design) part, a full turnkey contract could lead to price fixing and could be dominated by a few companies, so the contract changed to a form of separating the FEED part.

5.2.1. Competitive Bidding Process

Plant export transactions are concluded after the bidding process. Most of them are competitive bidding, and in some cases, bidders are restricted by examining the qualifications of bidders before bidding (Pre-qualification PQ, pre-qualification system), and bidding is conducted only for companies that have passed the PQ.

5.2.2. Long-term

Plant exports take a long time to proceed with and execute contracts. The contracting parties

reflect the environment at the time of bidding and, if successful, enter into a contract reflecting the contents of the bid. However, since it takes a long time until the completion of the plant, they mutually bear the risks associated with it. Representative risks at this time include Exchange Rate Risk, Raw material price fluctuations, Market Risk, etc.

5.2.3. Necessity of Project Post-Management

Project post-management is important in the plant industry. Even after the plant is completed, long-term and stable procurement of parts necessary for plant maintenance and repair is also important. Since a plant is a large-scale

facility that is operated over a long period of time, if the supplier cannot supply parts necessary for plant maintenance and repair for a considerable period of time after the completion of the plant, there is a risk that the plant will not be able to operate even after investing a large amount of money.

5.2.4. Importance of Project Finance

As the plant industry gradually changes into a capital-intensive industry that includes the financial industry, project finance.

The importance of project finance is being highlighted. The biggest feature of project finance is that creditors generally have no recourse against the assets of existing companies and can receive their investment amount back through the cash flow from the project. This has the effect of separating existing businesses and new financing.

The plant industry considers export financing as one of its important issues. This is because it requires a lot of time and money for design and survey for plant facilities and construction, and thus, due to the nature of capital-intensive industries, payments are made in a long-term deferred payment method.

6. Contract of Plant Exports

The plant order amount for 2023 achieved the target of 30 billion dollars (approximately 39.48 trillion won), recording the best performance in 8 years.

The Ministry of Trade, Industry and Energy announced that the total plant order amount last year was 30.23 billion dollars, achieving the original target of 30 billion dollars. This is an increase of 6.05 billion dollars, or 25.0%, compared to 24.18 billion dollars in 2022, and is the best performance in 8 years since 36.47 billion dollars were recorded in 2015. The target was achieved on the last working day of last year (December 19) when a 1.5 billion dollar order was received from Canada for a floating liquefied natural gas production facility.

In particular, the order amount in the Middle East last year was 11.42 billion dollars, a 22.3% increase from the previous year, which was formed through three summit economic diplomacy meetings with Middle Eastern countries in the past year, and the "new Middle East boom" The momentum of cooperation is evaluated to be tangible as actual contract performance in the plant order sector (Pascha, 2020).

The first state visit to Saudi Arabia by the President of our country, the dispatch of the Saudi order support team led by the Minister of Land, Infrastructure and Transport, the road show inviting the Minister of Transport and Logistics, and the hosting of the first Seoul NEOM exhibition in Asia

served as a solid bridgehead for One Team Korea companies to advance into Saudi Arabia. Last year (2023), the government promoted ‘One Team Korea’ and provided support at the government level to win orders for large-scale projects in the Middle East, including Saudi Arabia, Iraq, and NEOM City.

Looking at the status of orders for major Middle Eastern countries last year, Hyundai Engineering & Construction won \$3.085 billion worth of work in Saudi Arabia, Daewoo Engineering & Construction won \$793 million in Libya, GS Engineering & Construction won \$678 million in the UAE, and Samsung Engineering won \$105 million in the UAE and Qatar. Last year, the company won the largest order in Saudi Arabia (USD 5 billion) for the Amiral Petrochemical Project in the Middle East, and another large-scale project, the Jafurah Gas Plant Project, in succession.

The government’s overseas construction order target for this year is set at USD 35 billion per year. As the global construction market is expected to grow by more than 6% this year, we expect to achieve the annual order target following <Figure 1>.

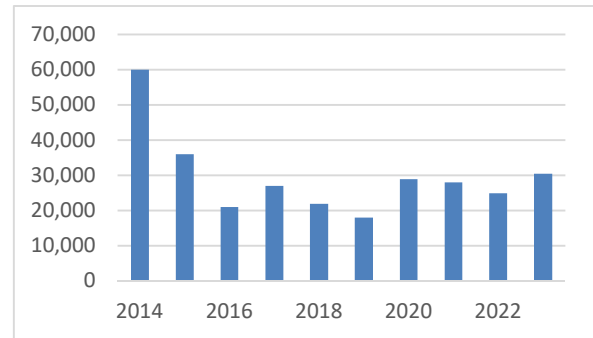
In order to achieve this, orders from the Middle East are absolutely important.

Among the Middle Eastern projects that are likely to win orders this year, Samsung Engineering is scheduled to win a USD 1 billion (approximately KRW 1.29 trillion) contract under the NEC (National EPC Champion) agreement with Saudi Aramco in the first quarter of 2024. Hyundai Engineering & Construction is waiting for news of orders for the Ruwais LNG Terminal (USD 4.5 billion), the first LNG import terminal in Abu Dhabi, and the Saudi Aramco NEC-related contract (USD 700-800 million) project in the first quarter of this year. Middle Eastern countries are also putting effort into building eco-friendly energy infrastructure such as green hydrogen and green ammonia in preparation for the post-oil era. Korean construction companies such as Samsung C&T, Samsung Engineering, and SK Ecoplant are already taking active steps to take the lead in the Middle East green hydrogen and renewable energy market, and this is expected to lead to orders for our companies.

In particular, Saudi Arabia is currently promoting ‘Vision 2030’. One of its core projects is the NEOM project with an investment of 500 billion dollars (650 trillion won). NEOM City is a project to build a future city 44 times the size of Seoul (26,500 km²) in northwestern Saudi Arabia, and is being promoted under the leadership of Crown Prince Mohammed bin Salman. Domestic construction companies such as Samsung C&T and Hyundai Engineering & Construction are also participating (He, 2021).

Meanwhile, Ministry of Trade, Industry and Energy has issue that as the new Middle East boom is expected to be in full swing in 2024 and demand for new industries such as

decarbonization is expected to increase, government will do their best to solidify the recent export growth trend of our economy through active support for plant orders based on data <Table 4>. It is desirable that Korean government should continue the good momentum from last year and achieve \$35 billion in overseas construction orders this year 2024.



Source: Korea Customs office 2024

Figure 1: Plant order amount (Unit: US\$ million)

Table 4: Plant order trends

(unit: 100mil US dollar)

	2021	2022	2023	2024 Mar	2024 Apr	2024 May	2024 Jun	2024 Jul	2024 Aug
order amount	27,043	24,181	30,234	6,188	13,574	14,378	16,319	18,069	19,161
asia	6,017	10,142	4,952	787	826	1,259	1,917	2,300	2,488
mid-east	11,559	3,527	11,417	2,712	10,006	10,201	10,340	10,689	11,438
africa	42	2,416	1,847	67	67	70	71	136	140
USA	4,236	5,505	10,142	1,839	1,845	1,932	2,988	3,601	3,736
europa	5,189	2,591	1,876	783	830	916	1,003	1,343	1,359

Source: Ministry of Trade, Industry and Energy 2024

Industrial facilities account for approximately 41.7% of the total market. The size of the global plant market is estimated to be approximately USD 3,137.8 billion as of 2023. The entire global market decreased in 2019-2020, and the main reason for the negative growth at that time can be analyzed to be the market slump in Central and South America, Europe, Africa, Oceania, and the Middle East. The global plant market continued to recover between 2020 and 2021 and is showing an increasing trend again, which seems to be driven by the plant markets in Asia and Europe. In addition, the Middle East, a major market for Korea, continued to be sluggish since 2020 but turned to growth in 2022.

Plant exports refer to comprehensive exports as a production unit that combines hardware such as machinery, facilities, or devices for the production of goods with

software such as engineering, know-how, and construction work required for their installation.

These plant exports show different transaction forms from general export products. Depending on the method of selecting the contractor, they are divided into competitive bidding contracts and voluntary contracts, and depending on the scope of work performed (the scope of the supplier's work), they are divided into FOB contracts and turnkey contracts. Meanwhile, depending on the payment method, they are divided into lump-sum contracts, cost plus fee contracts, and unit price contracts.

6.1. Export Contracts according to the Method of Selecting the Contractor

6.1.1. Competitive bidding contracts

When concluding a contract, open competitive bidding is usually conducted with multiple contractors. It is a contract concluded by making. Plant export contracts are usually conducted through competitive bidding, and the contract is usually established by signing a formal written contract through the following order: bidding notice and pre-qualification → decision and invitation of bidders → solicitation and bidding → successful bid and decision. The bidding notice corresponds to the incitation to offer, the bidding corresponds to the offer, and the successful bid corresponds to the acceptance.

6.1.2. Voluntary contract

Unlike a competitive bidding contract, this is a contract in which the orderer arbitrarily selects a contractor without competition or bidding and negotiates the contract terms face-to-face with that contractor. It is called a voluntary contract or a negotiated contract.

6.2. Export Contract according to the Scope of Business of the Supplier

6.1.1. FOB contract

This is a sales contract in which the exporter must load plant-related equipment and cargo onto a vessel designated by the importer at the port of shipment of the exporting country within a certain period of time, and the exporter bears all costs and risks until the loading on board is completed. The importer bears all costs and risks that occur after the delivery is completed. In other words, the delivery of ownership and risk of goods is on board.

At that time, the exporter transfers the risk from the exporter to the importer. The FOB contract in the plant export market mainly contains guidance necessary for the supply and installation of machinery.

6.1.2. Turnkey Contract

The term Turnkey contract is derived from the meaning that it can be used just by turning the key. It is a method in which the contractor delivers everything the ordering party requires, including financing, land procurement, design, construction, installation of machinery and equipment, test operation, and operation guidance for the target project, to the procurement ordering party. The official name in Korea is Design Construction Block Bidding Contract, and is also called a Plant Contract. It is a contract method in which the contractor proceeds with the construction with the full authority of the ordering party, and the ordering party trusts and relies on the contractor's technical capabilities.

Background of the Turnkey System adoption can be reviewed as follows;

The turnkey system was introduced in the 1990s to implement everything from design to construction as construction projects became larger, more complex, and more specialized. It is a contract method mainly applied to large-scale construction projects. Therefore, companies with world-class technical skills and competitiveness and project execution experience participate. In addition, since most projects are large-scale, several companies participate by forming joint ventures (Keola, 2023).

Additionally, there are types of turnkey contracts according to the type of construction.

D/M methodD/B method (Design Build) refers to cases where one company does the design and construction, but the construction is directly managed or subcontracted.D/M methodD/M method (Design Management) refers to cases where one company is responsible for the design/construction, but the construction manager has subcontractors for each process to carry out the project.

There are also advantages and disadvantages of the turnkey system.

First, from the perspective of the orderer.

The advantages of the turnkey system include one main contract for construction, the same designer, and the clear limits of responsibility, so the order can be placed with a lump-sum responsibility. Therefore, management work is minimized.

The best alternative can be selected through competition at the ordering stage (Liao, 2022). The construction period can be shortened with responsible construction. (The design and construction periods overlap with the fast track.)

The disadvantages of the turnkey system include the complexity of the ordering process increases, such as the preparation process to confirm responsibility, risk distribution, design intent, and funds when writing the bidding guide and ordering instructions. Unexpected results are produced due to the limited participation of the orderer. (Extended construction period, high management costs, liability limits, etc.)

There may be limitations in securing the quality of the entire project due to the profit maximization of the lump-sum contractor.

Second, the position of the construction company.

The advantages of the turnkey system include: Excellent communication between the construction and design personnel, which enables a shortened design and construction period. (Promotion of creative design and use of new technologies)

It has the effect of reducing construction costs by increasing the efficiency of project execution. It is possible to foster a specialized organization composed of experts from various fields.

The disadvantages of the turnkey system include: The burden of bidding is excessive. (Expenses required for bidding, etc.) The opportunity for small and medium-sized enterprises to participate in large-scale projects is limited.

Problems/measures of the turnkey system

Problem 1) Controversy over unfair evaluation due to insufficient design review during turnkey bidding

Measure 1) Objective evaluation criteria and design evaluation criteria must be established in advance(ICC, 2023)

Problem 2) During the turnkey bidding process, bidders incur pre-design costs, etc. Therefore, the cost is excessive and the company suffers a great blow.

Countermeasure 2) Compensation for a portion of the design cost of the failed company (Park,2022).

Problem 3) Competition based on performance and unreasonable low-price bidding -> Deterioration of quality

Countermeasure 3) Strengthening the evaluation criteria for bidding companies / Advancing the method of selecting successful biddersThis

7. Conclusions

7.1. Summary

Slowing economic growth in rival countries accelerates competition in overseas markets. The plant market is expected to see heated competition between domestic and foreign EPC (Engineering Procurement Construction) companies due to high interest rates and rising prices. In particular, as the domestic market in the United States is shrinking, major US EPC companies are focusing on overseas markets, and competition in overseas markets is becoming fiercer due to slowing economic growth in France, Italy, Spain, and the United Kingdom, which are competitors of domestic companies. However, there are opportunities in addition to these external crises. For example, Saudi Arabia is simultaneously carrying out around 10 projects in renewable energy, petrochemicals, and

smart cities, and various large-scale projects are being promoted in the Middle East market, such as 'Vision 2030', which is expected to have a positive effect on the growth of the plant market. In Korea, domestic markets such as private consumption and investment are shrinking due to the slowing housing market and high interest rates, so it is urgent to find a breakthrough through overseas markets. Accordingly, the government is providing intensive support for overseas exports, and the trade deficit has been significantly improved since last year due to brisk exports of automobiles, general machinery, and ships. Thanks to this policy direction, we can seek more opportunities to advance into overseas markets.

The plant industry is a high value-added industry that brings enormous profits and international fame to exporting countries. In addition, related industries also have a high potential for promotion, so Korea, which is highly dependent on trade, should recognize the plant industry as a key national export sector. In order to study the necessity of plant exports, competitiveness analysis and economic ripple effects of the plant industry are necessary.

In order to analyze the competitiveness of Korea's plant industry, ENR ENR has been consistently organizing data on the operating status of each overseas construction company for more than 10 years, such as sales by region and sector in the previous year, whether the business performance resulted in profit or loss, whether the number of professional engineers increased or decreased, and what the company's backlog is compared to the previous year. Despite the limitation that the data is arbitrary data from the industry, it is often used as data for analyzing overseas plant trends. (Engineering News Record) The number of companies included in the world's top 225 companies selected by ENR was analyzed to determine their international recognition. The sales volume was compared and analyzed by comparing the sales rankings of each country included in the world's top 250 companies selected based on total sales in each country. In addition, in order to see the qualitative level, the companies in the top 10 and top 30 groups were identified by country, and the rankings of Korean companies were identified to compare their international status, and the competitiveness of Korea's plant industry was analyzed by analyzing the combined competitiveness index.

As of 2023, only 11 companies are included in the world's top 225 plant companies. Although it has grown steadily from 5 companies in the 1990s to 12 companies in the 2010s, 21 companies in 2019, and 32 companies in 2023, the number of companies operating in the global market remains low compared to other countries such as the United States and China. This means that, except for some large domestic companies, they have not been able to enter the

global plant market and have not formed a group of companies entering overseas markets in various fields.

China entered the global plant market later than Korea, but it achieved rapid growth from the 2010s to 2017. As of 2023, 39 Chinese companies are included in the top 255 companies. As the number of domestic companies operating in the global market is small, their share of the global market is also low, but they are showing steady growth every year.

In order to study the economic ripple effect of the plant industry, we will analyze the production inducement effect, influence coefficient, and declination coefficient shown through the production inducement coefficient by industry to analyze the forward and backward linkage effects.

Most production activities in each industry are carried out to meet final demand such as consumption, investment, and export. When final demand for a certain good or service occurs, the ripple effect does not stop at the production of the relevant good or service, but extends to the production of all related industrial sector products, and the scale of total output is also determined. In this way, the level of total output in the production ripple process of each industry due to final demand is called the production inducement effect.

Production inducement coefficients refer to the units of output directly or indirectly induced in each industrial sector to meet the final demand when it increases by one unit. In addition, the production inducement coefficient has the property of a multiplier that indicates the ripple effect derived from final demand.

7.2. Implication

Institutional Improvement and Advancement Needed for Overseas Market Entry

The global plant market size in 2027 is expected to be USD 5.3557 trillion, with the Asian market leading the overall market and driving growth. It can grow or shrink depending on the continuation of geopolitical crisis factors. In terms of mid- to long-term outlook by sector, industrial facilities and power generation/desalination plants are promising, and growth is expected to be centered around the Asian market, where industrialization and urbanization are rapidly progressing.

On the other hand, in the oil and gas sector, where oil price levels determine market growth, growth is expected to slow down due to crude oil reductions in oil-producing countries. In addition, there are concerns that the petrochemical sector will also see a slowdown in growth as global regulatory risks such as climate crisis and environmental pollution prevention increase.

The global economy is expected to enter a recovery phase due to the economic recovery in the IT sector and increased investment demand resulting from supply chain

reorganization. According to the Bank of Korea's economic outlook report released in August last year, Korea's economic growth rate has been rapidly falling in the facility investment and construction investment sectors since 2022. In order to respond to this decline in domestic demand and economic downturn, it is important for domestic plant companies to secure sources of revenue by entering overseas markets.

In the short term, a strategic approach to global demand changes is necessary. Considering the large-scale projects in Saudi Arabia and the active industrialization and growth of emerging Asian countries, institutional improvement and advancement are urgently needed to enter overseas markets. In the long term, It needs to strengthen not only the fundamental plant industry capabilities but also the capabilities to respond to environmental regulations. In particular, government needs to focus on developing innovative technologies and upgrading the supply chain to secure the environmentally friendly global market, and government needs to develop fundamental capabilities such as engineering and financing.

As the water industry is an important industry, Korea needs to prepare to attract attention as an industrial policy. An industry is not made up of a few companies. Simply showing the importance of technology or the performance of companies will not be enough to attract the government's attention to policy. When Korea has a supply chain or ecosystem and clearly present what kind of ripple effects this will have on the national economy, Korea can establish the basis for policy support. In particular, it is important to emphasize the importance of the water industry through objective indicators by developing more specific statistical data related to the water industry.

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