The Recent Statistical Analyses of Korean Defense Industry and its Policy Implications (2012~16)1

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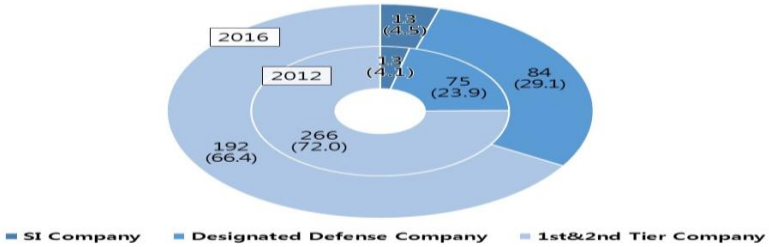
Abstract- The defense industry is important not only for national security but also for economic growth. In this regard, the new president, Jae-in Moon, pledged to foster the defense industry as one of his new commitments. This paper shows statistical results of surveying 289 Korean defense companies during recent 5 years (2012–16). It mainly contains the global status, sales revenue, export amount, number of jobs creation, R&D investments, etc. According to the statistics results of the defense industry, Korea is ranked in the 10th of the defense budget and arms production in the world in 2016. Even the amount of arms export has skyrocketed in recent years with the 9th in the world; however, the export volume is still 13.6% out of the total sales volume, and reached just 2.5% of the global arms export market. The global competitiveness is just 85–90% of its product and 80–81% of its business and government. In conclusion, in order to achieve the 'G7 Defense Industry' vision which is to export $5 billion dollars by 2022, the domestic-oriented monopoly structure must be turned into a competitive structure that maximizes economies of scale and strengthens the global competitiveness.

Keywords – Defense Industry; Statistical Analyses; Competitiveness

I. INTRODUCTION

It is essential to investigate the defense industrial dataset through an actual survey for setting up its policy direction, industry development, export facilitation, and civil & military technology cooperation. The purpose of this paper is to show statistical results of the actual survey in recent 5 years and suggest its policy implications to improve the defense industry environment as a new growth engine of Korea. More than 300 defense companies in Korea are surveyed from 2012 to 2016. The sample companies are divided into three groups, system integration (SI) company, designated defense company, and the tier company as the below Figure 1.

Unit: the number of companies, %



Percentages of Three Types of Defense Companies (2012 vs 2016)
Source: 2017 KIET Defense Industry Statistics and Competitiveness Paper, 2017. Same as below.
Notes: 1) Based on companies with annual defense sales of more than 0.5 million dollars in 2012, 0.3 million dollars in 2016
2) 314 respondents in 2012 and 289 respondents in 2016 respectively.

The paper consists of three sections. After a short description in introduction section, some key statistical analysis results of the Korean defense industry data are presented for the targeted period. Based on them, policy implications are suggested for the development of the Korean defense industry.

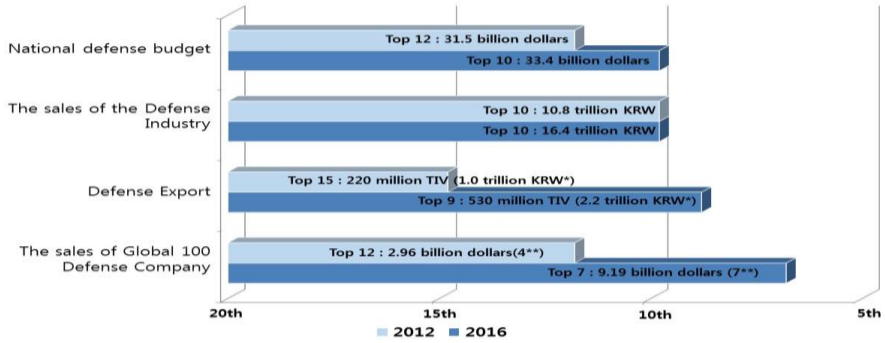
[1] The paper draws heavily on the Asia-Pacific Productivity Conference presentation materials at Seoul Nationa University in Korea on July 4~6, 2017.

II. THE KOREAN DEFENSE INDUSTRY STATISTICAL ANALYSIS

2.1 The global status of the Korean defense industry

The sales revenue of the Korean defense industry totaled 16.4 trillion KRW in 2016. Correspondingly, it ranked approximately as 10th in the world. At the same year, Korean national defense budget was over $33.4 billion, ranked as 10th in the world. The volume of exports is 530 million TIV2, ranked as 9th in the world. It is 2.4 times more than 5 years ago. The sales revenue of the Korean top 7 which are included in the global 100 defense companies was $9.2 billion in 2016. They includes KAI (48th), LIG Nex1 (55th), Hanwha (70th), Hanwha Techwin (71th), Daewoo Shipbuilding & Marine Engineering (73th), and Hanwha System (95th).3 Figure 2 shows the current global status of Korean defense industry in the world.

After comparison of advanced countries by key factors of defense industry, the global status of Korea is ranked 10th in the world as shown below in Figure 2.

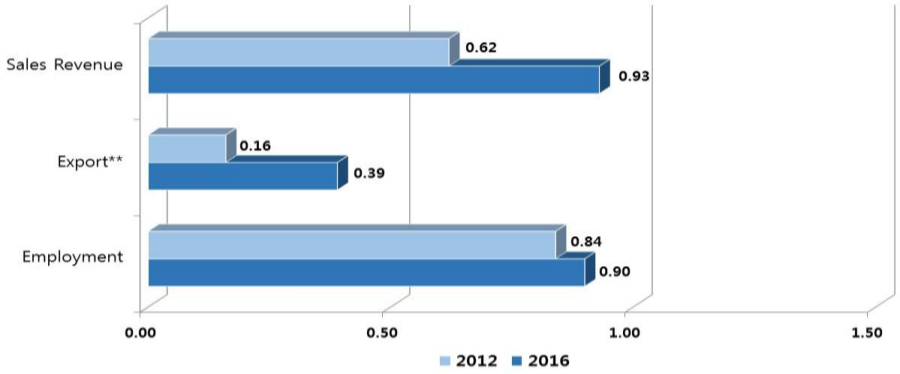


Global Status of Korean Defense Industry (2012 vs 2016)

Note: *( ) means the custom clearance basis

** ( ) means the number of defense companies

Compared to the Korean manufacturing industry, the sales revenue of the Korean defense industry showed just 0.93% in 2015. The defense export amount is also only 0.39% of the total export volume of Korean manufacturing industry in 2016. However, the number of total defense employee is over 36,821 personnel, which accounted for 0.90% of the total manufacturing industry, showed a relatively high employment ratio. The key parameters of Korean defense industry were highly increased compared to 5 years ago as shown below in Figure 3. This shows that the share of the defense industry in the whole industry is increasing.



Ststus of the Defense Industry compared with Manufacturing Industry (2012 vs 2016)*

Notes: * The export amount is for 2016, Sales Revenue and Employment are for 2015

**The export amount is based on the customs clearance.

2.2. Arms Sales Revenue

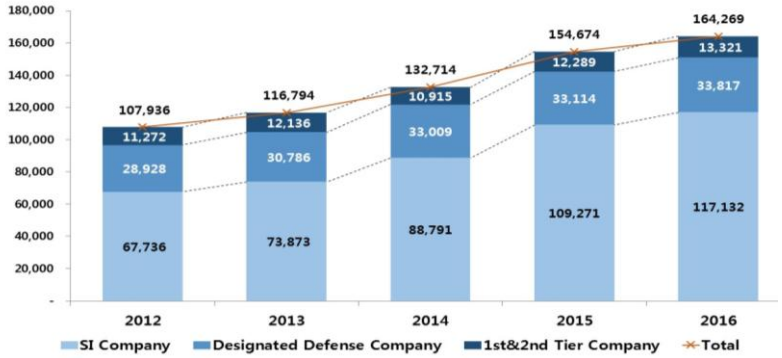
The sales revenue of the defense industry totaled 16.4 trillion KRW in 2016, 52.2% increase compared to 2012. SI companies accounted for 71.3% (11.7 trillion KRW) of total arms sales, while designated defense companies and 1st tier companies produced 28.7% (47.2 trillion KRW). Figure 4 shows the increasing trends of the defense sales

[2] Acronym of Trend Indicator Value and it means a total arms transaction volume.

[3] SIPRI, SIPRI Yearbook, 2017.

revenues in the last 5 years.

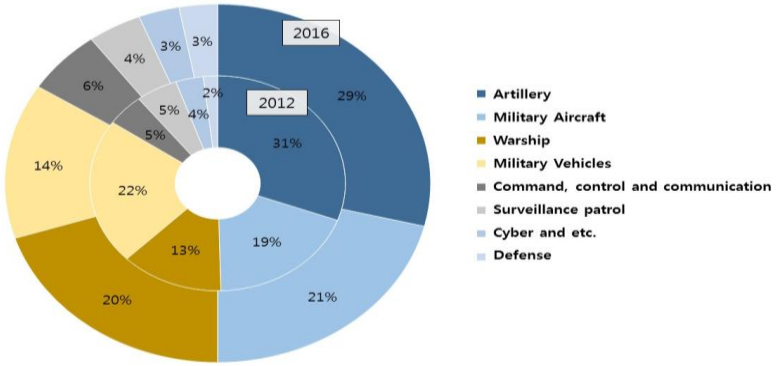
Unit: 100 million KRW



Sales Revenue of Three Types of Korean Defense Companies (2012~2016)

In the viewpoint of the arms sales revenue, it is increased by 52.2% compared to 2012. Especially, the growth rate of SI sales revenue shows over 72.9% during the same periods of time. The growth rates for designated defense companies and 1st tier companies are 16.9% and 18.2% increased respectively.

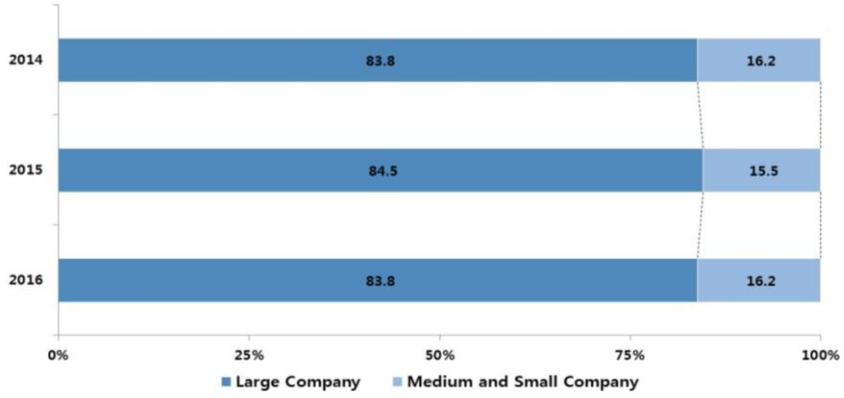
By the weapon systems, sales volume of artillery, military aircraft, and warship account for 69.9% among all weapon systems, where artillery (28%), military aircraft (21%), and warship (20%) respectively, as shown Figure 5 below. While the percentage of the warship is highly increased by 7%p (13%→20%) for the last 5 years, the military vehicles is dropped by 8%p (22%→14%) in the same period.



The Percentage Changes in Arms Sales By the Weapon Systems (2012-2016)

By the size of the company, the arms sales of large enterprises totaled 13.8 trillion KRW (83.8%) whereas the small and medium enterprises (SMEs) recorded slightly over 2.6 trillion KRW (16.2%). It shows a monopolistic or oligopolistic industry structure by a small number of big enterprises in Korea as shown Figure 6 below.

Unit:%

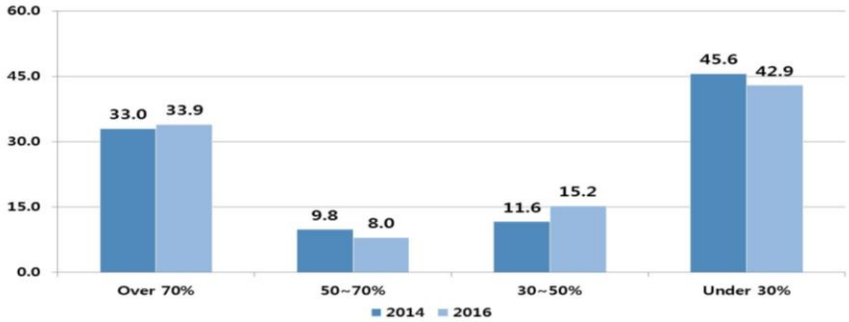


The Sales Ratio Depending on Company Size (2014~2016)

Especially, the arms sales ratio as a % of total sales4 was an average of 11.4% in 2016, where 3.6%p increase compared to 2012. The ratio is relatively stable, but there were big differences by the company types. Generally, 1st tier companies showed the highest arms sales ratio with 15.6%; however, both SI and designated defense companies showed 13.7% and 6.8% respectively. Only three companies, LIG Nex1, Hanwha defense and Hanhwa system, were dependent on nearly 100% arms sales ratio. On the other hand, most of SI companies showed lower than 10% of their arms sales ratio. It is caused by a heavy reliance of domestic demand, monopolistic industry structure, and high entry barriers, etc.

Correspondingly, the arms sales ratio was poles apart with the number of defense companies in Korea. The companies with over 70% of arms sales account for 33.9%, while those under 30% account for 42.9% in 2016 as shown Figure 7 below.

Unit:%



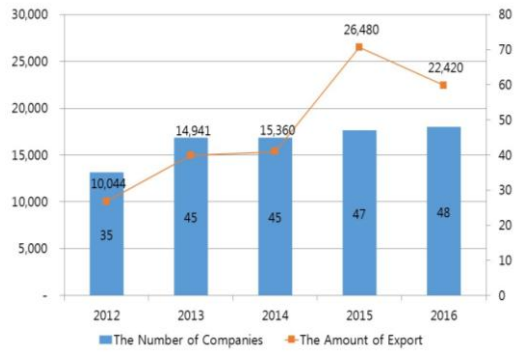
The Ratio by rhe Arms Sales as a % of Total Sales (2014 vs 2016)

2.3. Arms Exports

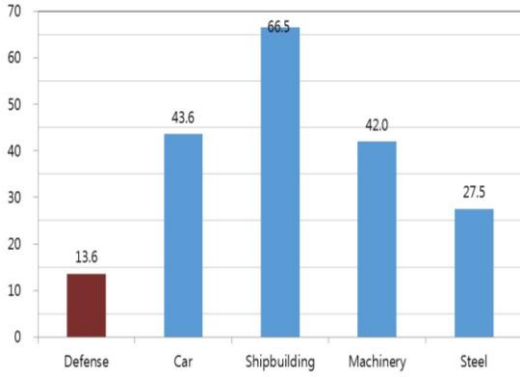
The amount of arms exports has recorded over 2.2 trillion KRW in 2016. It has highly increased over 2.2 times compared to the amount of 1.0 trillion KRW in 2012. It mainly relies on the both effort of leading defense companies and continuous support by the government. The number of export companies increased 1.4 times from 35 to 48 within 5 years, either.

Despite of its huge increase of arms export sales, the arms export ratio as a % of sales is just stayed at 13.6% in 2016. It is significantly lower than the ratio of the car industry (43.6%), steel industry (27.5%), shipbuilding industry (66.5%), and machinery industry (42%) in Korea as shown Figure 8 below. Compared to other countries, Israel's export ratio is over 75% of their total defense sales, and USA, UK, and France are also over 20–30% of the arms export ratio.5 Overall, the rapid increase of arms export is highly outstanding. However, it should continue to increase its amount of arms export volume to enhance not only for its scale economy but also for global competitiveness in the future.

Unit: 100 million KRW, number of companies



Unit: %

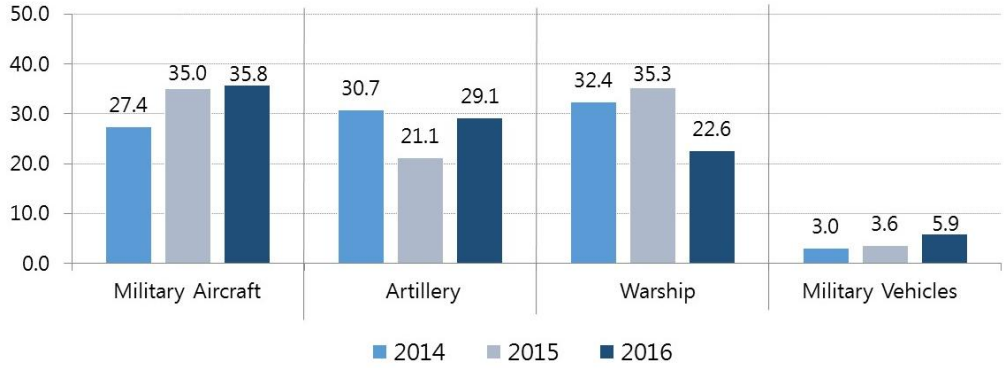


The Status of Arms Exports

[4] The arms sales as a % of total sales shows companies' dependency on defense products among its total products.
[5] IHS Janes, 2017.

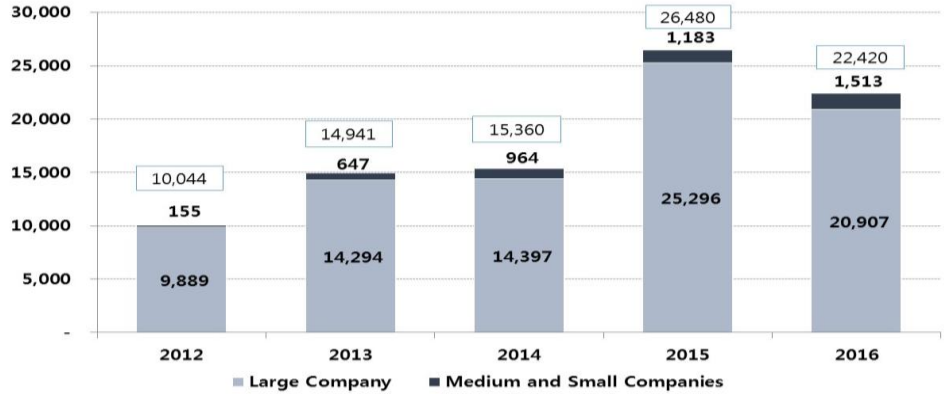
Notes: The data of relevant industries are based on 2015
Actually, arms export sales during 2012–2016 have increased up to 22.2% annually. By the company types, SI companies covered 74.6% of total in 2016. This shows that SI companies mainly dominate arms exports in Korea. On the other hand, designated defense companies and tier companies only sold their products abroad in the amount of 0.54 trillion KRW and $0.03 Trillion KRW respectively. Especially, the export amount of 1st tier companies covered only 1.4%. However, export sale of designated defense companies has been continuously increasing by 195.5% compared to 2012.
By the weapon systems, military aircraft placed at the top in the amount of exports with 35.8% (803 billion KRW) in 2016. The export sales of artillery field ranked at the 2nd with 29.1% (653 billion KRW). The third rank was warships with 22.6% (507 billion KRW) as shown Figure 9 below. The export sales of military vehicles recently drew attention at the 4th with 133 billion KRW.

Unit:%



The Status of Arms Exports by the Weapon Systems (2014~2016)

In 2016, the proportion of the large defense enterprises' exports was 93.3% (2.1 trillion KRW), occupying most of the export amounts, where the ratio of exports of the SMEs occupying 6.7% (151 billion KRW) as shown Figure 10 below.
Unit: 100 million KRW



The Status of Arms Exports by the Company Size(2012~2016)

2.4. Arms Investment and its Empoolyment
In 2016, total investment of arms manufacturers in Korea recorded 537 billion KRW, which was an increase of 13.3% compared to 2014. The portion of R&D investment in companies' total defense sales is 1.3%, down 0.2%p from 1.5% in 2014. During the same period, the R&D investment of the defense companies' own was 192 billion KRW of total defense investment in 2016 as shown Figure 11 below. Especially, the equipment investment of the defense companies was 344 billion KRW which is merely 2.7% of companies' total defense sales. Overall, the defense R&D investments in Korea mainly covered by the government, 2.6 trillion KRW, while the investment of defense company itself owns by 7.3%. It means that an active incentives and policy changes are needed to increase

the R&D investment by the defense companies including intellectual property right, acquisition system change, policy change from arms development request by the planning period, etc.

Table 1 The Status of Arms Investment (2012~2016)

Unit: 100 million KRW, %

	Section	2012[1]	2013[2]	2014[3]	2015[3]	2016[3]
R&D Investment	Defense R&D investment (A)	1,952	2,351	1,674	2,129	1,923
	Defense Sales (B)[4]	73,751	96,937	112,130	139,796	143,308
	Ratio (A/B)	2.6	2.4	1.5	1.5	1.3
Equipment Investment	Defense equipment investment (C)	2,325	3,126	3,068	4,050	3,449
	Defense Sales (D)[4]	73,751	96,937	104,283	125,575	129,631
	Ratio (C/D)	3.2	3.2	2.9	3.2	2.7
Total	Defense investment(A+C)	4,277	5,477	4,742	6,179	5,372
	Defense Sales(D)[4]	73,751	96,937	118,660	142,413	146,849
	Ratio (C/D)	5.8	5.7	4.0	4.3	3.7

Notes: 1) 24 companies with more than 50 billion KRW in defense sales in 2012, based on the 15 and 17 companies investing in R&D and facility

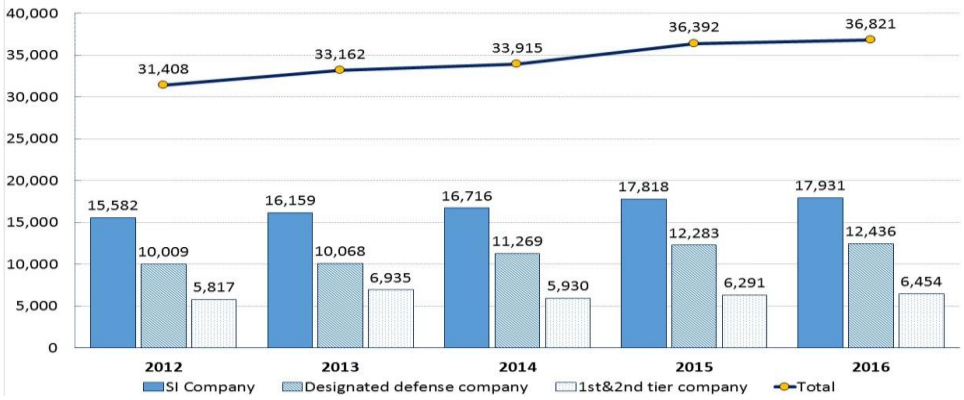
2) 29 companies with more than 50 billion KRW in defense sales in 2013, based on the 27 companies investing in R&D and facility

3) Based on the 50/64, 65/73, 48/54 companies investing in R&D and facility in each year from 2014 to 2016

4) Total amount of company's own investment in defense R&D and facilities

Overall, the total number of arms employees in the defense companies in 2016 recorded 36,821 personnel. The growth rate was relatively high with 17.2% compared to 2012 as shown Figure 12 below. The main reason of employment expansion was due to its arms sales growth with the continuous increase of domestic defense acquisition expenditures and exports.

Unit: The number of people

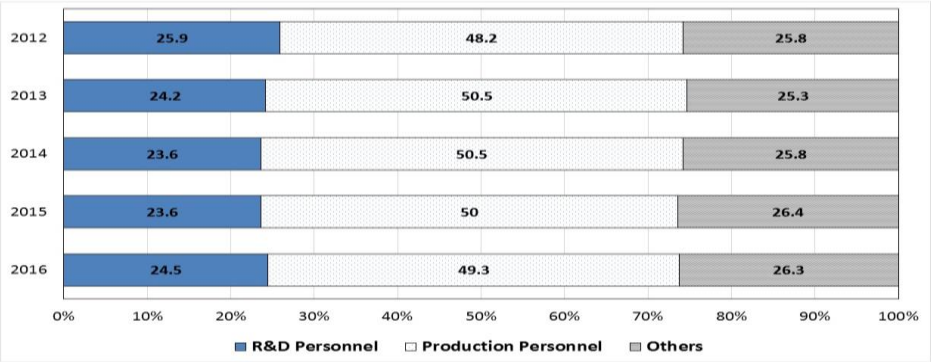


The Status of Defense Employment by the Company types (2012~2016)

It was remarkable that R&D personnel occupied a high proportion, 24.5%, in the Korean defense industry in 2016. The high ratio of R&D personnel is more than 3 times of the manufacturing industry, 7.3%. The production personnel amounted to a 49.3% of employees, followed by others with 26.3%. Therefore, SI companies, designated

defense companies, and 1st Tier companies have a portion of R&D personnel is 29.1%, 17.7%, and 24.7% among the total. By size, large companies account for 25.9% of R&D personnel while SMEs account for 22.0% as shown Figure 13 below.

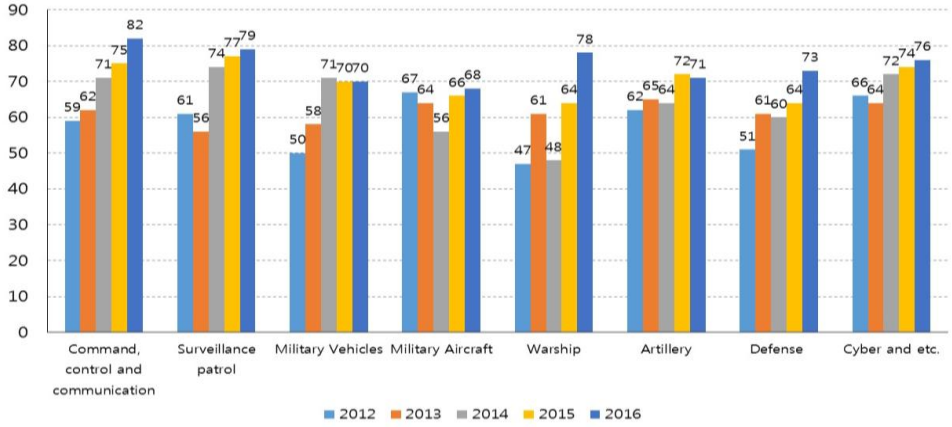
Unit:%



The Ratio of the Defense Employment by Sector (2012~2016)

The increasing rates of operation show that the defense industry should not rely on domestic demands in the future. A lesson learned from the past is that it is essential to get a scale economy by boosting up the exports volume as shown Figure 14 below.

Unit:%



Operating Rate by the Weapon Systems (2012–2016)

By the weapon systems, C4I and ISR had the highest with 82% and 79%. Military aircraft showed only 68% operation rate on the other hand. It means that only the domestic defense market cannot maintain its efficiency for the competitive structure. That is why military aircraft companies have to expand their market share in the global market nowadays.

2.5. The Status of Global Competitiveness

The global competitiveness of the Korean defense industry was relatively low compared to several advanced countries (or competing products) in the world.

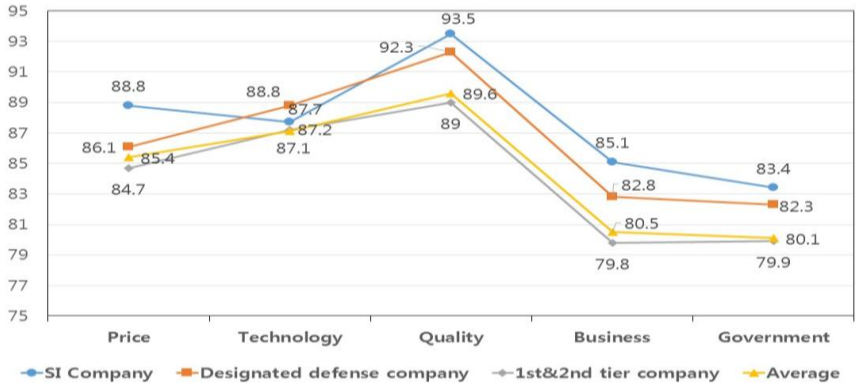
The 2013 survey results show the low competitiveness of defense industry. However, it is getting better as judged by the results in 2017. In a detailed analysis, price competitiveness recorded 85%, while technology and quality competitiveness recorded 87% and 90% respectively. Also, the percentages of business and government competitiveness were only 81% and 80% each as shown Figure 15 below.

Unit:%

Competitiveness of the Korean Defense Industry (2013 vs 2017)

By the company types, SI company competitiveness shows 83.4–93.5% of their products, where the competitiveness of business and government are relatively low for 85.1% and 83.4% each. Both designated defense and 1st tier company's competitiveness was overall lower than SI companies as shown Figure 16 below.

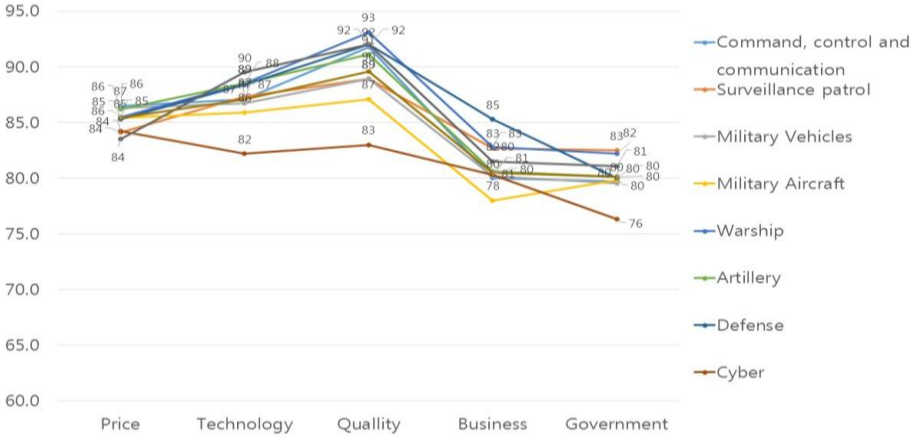
Unit:%



The Status of Competitiveness by the Company Types (2017)

By the weapon systems, the competitiveness of warship was the highest, whereas the competitiveness of C4I and Cyber were relatively low. Overall, there were large gaps between weapon systems from 82% to 93% for their product competitiveness, and the competitiveness of their business and government are from 76% to 85% as shown Figure 17 below.

Unit:%



The Status of Competitiveness by the Company Types (2017)

The reasons of low competitiveness mainly are due to on their high production costs, limit of defense core technology development capability, low level of quality competitiveness, low brand value, and lack of export promotion policy and marketing, etc.

2.6. Summary of the Statistical Results

In summary, the statistical analyses are the key indicators of the Korean defense industry to diagnose the present and prepare for the future. Total arms sales volume has been increased by 52.2% compared to 2012. Of these, 71.3% were consisted of SI companies. The top 3 is consisted of artillery, military aircraft, and warships. Moreover, the arms sales as a % of total sales were relatively low only 11.4% on the average in 2016.

In a similar vein, the actual exports volume has recorded a high figure of 2.2 trillion KRW. However, the ratio of defense exports to national manufacturing export amounts was only 0.39%, which is relatively low compared to other major countries. Major exported items include T-50 trainer, K-9 howitzers, and submarines, and it shows a slight change from components to end items within recent years.

Meanwhile, 36,821 personnel for the Korean defense industry in 2016. 24.5% of them work for R&D personnel. The sales per capita have recorded 446 million KRW in 2016 as shown Table 1 below.

Table 2 Key Indicators of Korean defense industry (2016)

Type	Results
Arms Acquisition Budget (A)	11.6 trillion KRW
Sales (B)	16.4 trillion KRW
Export (C)	2.2 trillion KRW
Employment (D)	36,821 employees
Export Ratio (C/B)	13.4 %
Sales Per Capita (B/D)	446 million KRW

Second, in productivity terms, the manufacturing cost ratio is 83.3%, which is 11.8%p higher than the manufacturing industry's average as shown Table 2 below. Among these, 66.6% are composed of the raw materials. Also, the ratio of operating profit to sales is 3.6% in the defense sector which is 0.2%p higher than the total. The average operating rate of the defense industry is 72.5%, which is the almost same with the manufacturing industry, 72.6%.

Table 3 Productivity of Korean defense industry (2016)

Type	Results
Manufacturing cost ratio	83.3 %
Raw material ratio	66.6%
The ratio of operating profit to sales	3.6%
operating rate	72.5%

III. POLICY IMPLICATIONS AND CONCLUSIONS

3.1. Policy Implications

Korean defense industry's total sales have increased by an average of 11.1% each year during 2012–2016. The Korean defense industry's sales growth is higher than the manufacturer sales growth (-1.7%). In this rapid growth, the role of SI companies has been prominent, which accounted for 71.3% of the total sale. Beyond the rapid growth of the defense industry, there are obvious limitations for the future growth.

Arms sales are dependent on domestic markets of almost 90%. Therefore, its growth rate is wholly decided by the budget of arms purchase in the government. In this situation, the growth of the Korean defense industry has a limit of its growth without the innovative improvement of the industrial structure for exports. Therefore, the Korean government should focus on its stepwise improvement from the domestic-oriented to the global market-oriented industrial structure in the future. For example, the current 'defense designated products & companies system' should be abolished for to promote industry innovation and competition.

The amount of arms exports is highly increased over 2.2 times compared to 2012. However, it was still insufficient compared to the advanced countries export ratio, 25–30%, in the world. Especially, the lack of export volume was

mainly caused by the low global competitiveness of the arms products. The price competitiveness of the Korean defense products was analyzed about 85% of the major advanced countries (or competing global products).
To expand the export volume, indeed, it is essential to change the current 'Cost Subsidy Systems', which hinders price competitiveness enhancements of arms products without strategies in the future. Also, the marketability and economic feasibility test must be expanded at the defense program analysis of early phases such as 'Defense Acquisition Requirement Verification System' by the Ministry of National Defense.
The number of employees has increased by an average of 4.1% each year during 2012–2016. The increasing rate is lower than arms sales rate, 11.1% in the same year. It has resulted mainly from the low rate of operation. It was just 72.5% which means the both investment and job creation will be difficult even if some additional programs are carried out. Therefore, the low rate of operation is a common symptom of the both large companies and SMEs, although their utilization ratio is increasing.
By the weapon systems, the rate of operation of C4I was the highest (82.0%) while that of military aircraft was the lowest (68.0%). Although there is gaps among the weapon systems, all weapon systems' average rate of operation (72.5%) is similar with 72.6%, which was an average rate of operation of manufacturing industry. Nevertheless, by increasing arms export volume and removing the barrier which hinders civil-military integration, the rate of operation can be improved. As a result, the defense industry can create new jobs as solving with the structure depending on the domestic market. Actually, one of the unique characteristics of Korean arms industry is the companies have many high-quality human resources in R&D departments. Therefore, arms employment policy should be encouraged by expanding of outsourcing to reach the scale of economy in the future.
In the perspectives of manufacturing cost and profit, manufacturing cost ratio is 83.3% of arms sales. Also, the ratio of raw material cost increased 7.7%p over the 2012, while the labor cost and other miscellaneous cost has decreased by 4.1%p and 1.5%p, respectively.
In terms of operating profit ratio of the arms industry, it has dropped 0.5%p over the previous year and recorded 3.6% as an average in 2016. It is 3.0%p lower than the manufacturing industry. Also, the arms sales ratio among the total sales is just 11.4% of the whole defense industry in Korea.
Even though the defense industry has a difficulty with the limited demand problem, most of the defense companies try to increase their profits by a commercial diversification strategy within a company over the last decades. The defense industry has played a role as a good window to develop their technology with the use of the government budget, and do a critical role to extend their business with intra spin-offing within the company itself.

3.2. Conclusion

This statistical report is based on the recent arms industry dataset for the recent 5 years, and could provide valuable information for the development of the Korean defense industry in the future. Actually, it has numerous statistical data including arms sales, export volume, employees' status, rate of operation and others. Remarkably, Korea is a nation having records of the 10th defense budget and the 10th of arms production in the world. Even the arms export has skyrocketed in recent years with the world ranking of the 9th; however, the export volume is still 13.6% of total sales volume, and reached just 2.5% of global arms export market. The global competitiveness is just 85–90% of its product and 80–81% of its business and government because the Korean defense industry concluded that it still remains a domestic-oriented market structure with high production costs, low productivity and global competitiveness. Obviously, it is noticeable that major countries nowadays place great effort to increase their export volume to reach its scale economy and enhance global competitiveness. We should let these case studies be a good lesson for us. In conclusion, in order to achieve the 'G7 Defense Industry' vision which is to export $5 billion dollars by 2022, the domestic-oriented monopoly structure must be turned into a competitive structure that maximizes economies of scale and strengthens global competitiveness.

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V. BIBILIOGRAPHY

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