

DEFENSE INDUSTRY CLUSTERS IN TURKEY

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All countries strive for a capable national defense supported by a strong national defense industry. Supporting national defense with imported defense systems has many limitations and risks because the terms of arms trade agreements between countries may easily be influenced by the political climate of the signatories. As a result, establishing an independent national defense requires a strong national defense industry. Furthermore, exporting defense systems may be an important source of national income. National defense industries mostly consist of large-scale defense firms that have the resources required for big defense contracts. However, small to medium enterprises (SMEs) do not have the necessary resources, therefore they are at a disadvantage. To overcome this handicap and be part of the business, defense industry clusters mostly consisting of SMEs are being established. Provided that there is good national planning and support in this area, defense clusters consisting of SMEs may play a significant role in industry. SMEs have a chance to offer specialized services, special or customized products when needed. As a result, large defense firms subcontract certain portions of defense projects to SMEs. Since 2010, Turkey has shown signs of continuous improvement in defense industry clustering. In parallel with these developments, this study discusses the importance of clustering in the defense industry, briefly presents the state of the Turkish defense industry as highlighted by national statistics, and presents the current status of defense clusters in Turkey. The novelty of this article consists in its assessment of Turkish defense clusters.

Key words: *defense, defense industry, clusters, clustering, defense clusters, industry clusters, defense industry clusters, Turkey, Turkish defense industry, Turkish defense industry clusters.*

1. INTRODUCTION

In addition to large-scale defense companies, small to medium enterprises (SMEs) may also contribute significantly to the national defense industry. To benefit from SMEs to the maximum extend in defense industry, defense industry

clusters are being established. On the other hand, being a part of a defense cluster has many advantages for SMEs. First of all, defense clusters are generally supported by the government with certain incentives such as tax reductions, cheaper rents, ease of access to funds and credits, etc. Defense clusters also promote

themselves through many advertising campaigns and various national or international events such as defense industry exhibitions. Members of defense clusters have increased communication and synergy. These clusters also attract skillful and educated human resources. Usually, large defense companies have offices in defense clusters. As a result, SMEs and big defense companies become geographically close and this provides opportunities for both parties. For instance, the main defense contractor, a big defense company, may and in most cases should subcontract certain portions of the project work packages to SMEs. To stay competitive, defense SMEs are specialized in various products and services. Through specialization, they can produce certain products or equipment with high quality. SMEs may also provide expert services in specific defense industry areas. Overall, defense clusters increase the size and capability of the defense industry by including SMEs.

In Turkey, the importance of defense clustering is also recognized and acknowledged by high level government officials. Recently there have been many initiatives from government organizations and private sector. Clusters related to defense, security, aviation, and space have been established since 2008. This study investigates the current status of defense industry clusters in Turkey and is structured in the following way. In the second section, an overview of the Turkish defense industry is provided based on recent national statistics in the field. Furthermore, key organizations in the industry are identified. The third section briefly

reviews the literature discussing the importance of clustering and life cycle of clusters. Defense industry clusters are separately discussed in the following section. In the fifth section, a brief discussion on the Turkish defense industry clusters is provided. The conclusion section summarizes the authors' assessment of Turkish defense clusters.

2. AN OVERVIEW OF TURKISH DEFENSE INDUSTRY

The Turkish Defense Industry was established with the birth of Republic of Turkey. The country inherited very little defense industry from the Ottoman Empire. At the time, defense industry growth was slow since there were many other areas requiring investment for improvement such as education and health. Up until the 1960s, the industry grew at a slow pace. In the 1960s, limitations on the use of exported defense systems led to a set of initiatives to strengthen the national defense industry. Foundations supporting different branches of armed forces were started in the 1970s. A foundation is a nonprofit corporation that supports other organizations with funds collected mostly from charities. The most recognized one is Turkish Armed Forces Foundation. Firms supported by these foundations were founded. Aselsan (1975), Aspilsan (1981), Havelsan (1982) are only a few examples of these firms. In the 1980s and 1990s, Turkish firms started joint development of various defense systems with foreign partners. They also became subcontractors to foreign defense firms in many defense projects. For example,

certain systems and parts of F-16 Fighting Falcon Fighter Aircraft, one of the most successful and widely-used multirole fighter aircraft in the world, were subcontracted to Turkish firms. During the 1980s, there were many structural reforms in the Turkish government. Naturally, the government organizations tasked with defense system acquisitions and defense industry support were also reformed. New government organizations based on novel and improved regulations to better support the defense industry were established. For example, in 1985, law number 3238 established the Undersecretariat for Defense Industries (SSM) that works based on a special regulation. During the 1990s, new defense firms, completely funded by the private sector, were started. Up to that time, almost all defense firms were either supported by government or foundations.

In 1990, one of the most important Turkish defense industry associations was established. First, it was named as Defense Industry Manufacturers Association. Later, in 2012, its name was changed to Defense and

Aerospace Industry Manufacturers Association to reflect the inclusion of many aerospace firms into the association. During the 2000s, the long term investments started to pay off and many defense systems were delivered to Turkish Armed Forces. In addition, some of these systems and equipment were exported to other countries.

2011 was an important year for the Turkish defense industry. The first warship completely designed in Turkey started its service in the Turkish Navy. The ship, named TCG Heybeliada, is the first corvette in the MILGEM corvette class. Around 80% of the MILGEM corvette was produced in Turkey including the combat management system. The development of MILGEM corvette, ATAK helicopter, ALTAY tank, ANKA unmanned aerial vehicle, HURKÜŞ training aircraft are among the main achievements of the Turkish defense industry over the years. To sum up, the Turkish Defense Industry has been on the rise for the past fifty years. Currently, Turkey is able to support Turkish armed forces with many national defense systems.

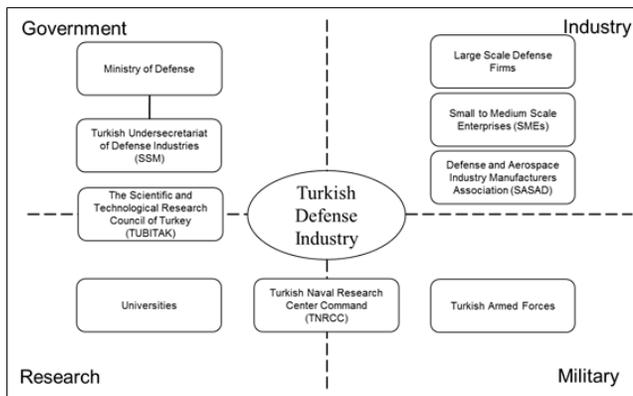


Fig. no. 1. Turkish Defense Industry Main Stakeholders Overview

A holistic view of defense industry includes government, military, industry, and research components. **Figure 1** shows the main stakeholders in the Turkish defense industry, as well as some of the key actors notably contributing to the national defense industry.

In Turkey, the **Undersecretariat for Defense Industries (SSM)** is tasked with the acquisition of strategic and major defense systems. SSM was established as a branch of the Ministry of Defense in 1985. It currently employs hundreds of defense acquisition specialists. SSM also acts as a key player in shaping long term defense policies. The organization is considered a success factor in achieving the current state of national defense industrial capability.

Another key player in the Turkish defense industry is the **Scientific and Technological Research Council of Turkey (TUBITAK)**. This organization was established in 1963 primarily to act as a consultant to the government on science and technology policies. Over the years, TUBITAK has grown significantly and now employs thousands of researchers. TUBITAK conducts research in many areas and naturally, a portion of the resources are reserved for defense related research. The organization also funds research conducted by universities, organizations, and firms. In some cases, TUBITAK takes on defense projects requiring a significant amount of research and development (R&D). Such defense projects are not

attractive to private industry because of the high risk in R&D defense projects.

The Turkish Naval Research Center Command (TNRCC) is a unique organization in Turkey. It was founded in 1998 as a military research organization within the Turkish Navy. It primarily conducts applied research, develops prototype defense systems and full-scale defense systems with industry partnership. The experiences acquired with TNRCC will be used as a starting point for establishing other military research organizations. Therefore, it could be considered as a role model. TNRCC was the key organization in the development of the GENESIS combat management system used by the MILGEM corvette. In time, GENESIS became a long-term program and currently is the primary combat management system for many Turkish Navy ships.

The Defense and Aerospace Industry Manufacturers Association (SaSaD) is the foremost private sector association for defense and aerospace companies and was supported by the ministry of defense during its establishment in 1990. It started with 12 companies and now, represents 137 companies including 4 defense industry clusters. SaSaD became the primary association representing the defense, aerospace, space, and security companies in Turkey. The mission of the association is “to contribute to a powerful defense sector by gathering Turkish defense industry establishments under SaSaD umbrella”. As stated in the SaSaD 2015/2016 defense directory [27], the association contributes to the Turkish defense industry in many ways.

Hence, SaSaD

- ensures that the strategic interest of Turkish Defense, Aerospace, Space and Security industry are properly represented;
- creates the best climate in which its members can do their business;
- represents a single point of contact for its members and new comers to the sector;
- deals and lobbies with government officials for the sake of the defense sector;
- helps to identify domestic and international market opportunities and organizes events to build synergy and cooperation among its members, and national and international sector representatives, as well as neighboring sector players
- gathers data and statistics on defense industry;
- prepares reports on defense sector performance.

To understand the current status of Turkish defense industry, let's examine the latest statistics. As indicated earlier, the Defense and Aerospace Industry Manufacturers Association (SaSaD) publishes yearly defense industry statistics. The latest report included statistics based on the 2014 performance. The report for 2015 has yet to be released. The 2014 report is prepared based on a survey of 78 members of SaSaD. Note that these members constitute over 90% of the Turkish defense industry. The report [28] indicates that the total sales of the defense industry in Turkey are over \$5 billion. While the total export is around \$1.8 billion, the total import is just over \$1.3 billion. The rise of the Turkish

defense industry may easily be observed by examining the increase in the size of the total contracts. In 2013, the size of the total contracts awarded was over \$8 billion. In 2014, it reached to \$11 billion. The increase is over 35%. Currently, there are over 31 thousand people working in the industry. However, we have to note that while the contracts awarded are on the rise, the manpower stays the same for the last couple of years. Table 2 shows the Turkish defense industry overview as of 2014.

The total defense systems sales may be divided into the following areas: Command, control, communications, computers, intelligence, surveillance and reconnaissance (C4ISR), aviation and space, information technologies, land vehicles, sea vehicles, and other. C4ISR has highest share in the sales. Table 3 shows the defense industry sales by areas.

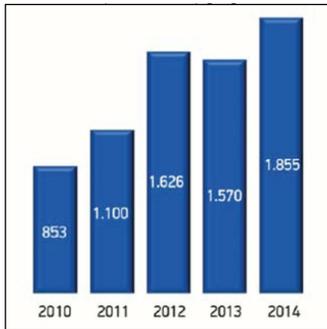
Turkey exports defense systems to many countries. Currently, USA and Europe are the main buyers of Turkish defense systems. The value of defense systems exported to USA was \$581 million dollars in 2014. \$418 million and \$856 million dollars' worth of defense systems was exported to Europe and to the rest of the world, respectively. 31% of total export goes to USA. 23 % of total export goes Europe and over %46 of total export goes to other countries. In the last five years, the total export increased from \$853 million to \$1.855 billion. This amounts to a 217% increase in the total export. Table 4 shows the total Turkish defense systems export over the last 5 years.

Table 1. Turkish Defense Industry Overview as of 2014 [28]

Total Sales	\$5.1 Billion
Total Export	\$1.8 Billion
Total Import	\$1.3 Billion
Total Contracts	\$11 Billion
Total R&D	\$0.88 Billion
Total Manpower	31242 personnel

Table 2. Turkish Defense Industry Sales by Areas [28]

Land Vehicles	\$521 Million
Sea Vehicles	\$298 Million
Information Tech.	\$219 Million
Aviation and Space	\$1204 Million
C4ISR	\$1450 Million
Other	\$1409 Million

Table 3. Total Defense Export over the Years (in \$ Million) [28]

3. INDUSTRY CLUSTERS

Today, even acquiring cheap labor is becoming ineffective in a competitive global economy. Therefore, more innovation, successful research and development (R&D), and high intellectual capital are needed to stay competitive. The SMEs have limited resources to invest in innovation, R&D, and intellectual

capital. Clustering is seen as a solution for SMEs to stay competitive against large companies with more resources. Thus, clustering in various industries is gaining attention.

Porter introduced the notion of business clustering with his famous work titled *Competitive Advantage of Nations* in 1990 [9]. According to Porter, business clustering is a geographic concentration of firms from a particular industry with the firms from supporting industries and related public and private institutions [10]. Porter states that “A cluster allows each member to benefit as if it had greater scale or as if it had joined with others without sacrificing its flexibility.” [10]. Porter’s diamond model is used by many researchers in analyzing the competitiveness of nations and clustering in various industries [11].

Clusters may be developed based on industrial similarity or interdependency [23]. According to Jacobs and De Man [13], there are three types of clusters: Regionally concentrated industries, sectors or groups of sectors, or production chains.

The mature clusters developed based on a good strategic plan share some common characteristics [12]:

- Common customers,
- Common suppliers,
- Shared infrastructure,
- Shared pool of human resources,
- Shared opportunities for education and training of employees,
- Shared access to research and development institutions, universities, and non-profit organizations,
- Common risk, capital, and market structure.

Similar to biological systems, clusters go through various phases

in their life cycle. According to Porter, these are birth, evolution, and decline [10]. Rosenfeld [18] defines another life cycle model for clusters. In Rosenfeld's model, there are four phases in the life cycle of a cluster. These are embryonic, growth, maturity, and decay phase. These two life cycle approaches are in fact similar. The embryonic stage of a cluster may be the result of innovations, inventions, or inward investment [18]. Sometimes, the birth of a cluster occurs naturally based on market needs created by demanding consumers. For instance, the textile clustering in Denizli region of Turkey is such an example [3]. The clusters in a region can give birth to other clusters. The environmental cluster in Finland is developed due to the pollution created by other industries such as energy, forestry, metals, and chemicals [10]. The growth stage occurs with the development and restructuring of the related market attracting more entrepreneurs for new spin offs and startups. In its growth stage, the cluster starts to evolve and gains a momentum in creating and maintaining a competitive advantage. More firms are attracted to the clusters. The support to the cluster increases as the government, institutions, and supporting industries strengthen the relations with the cluster. In this stage, the competition within the cluster also increases. In the maturity phase, the processes and services become routine and cost becomes a key competitive advantage. During the last stage, the cluster is being challenged by alternative clusters and industries. In this decay stage, the cluster starts to lose its competitiveness and slowly

decays in time due to both internal and external factors.

Kuah states that starting a business in a cluster has many benefits for the startup [5]. According to Porter [10], being in a cluster has benefits such as:

- Better access to employees and suppliers;
 - Access to specialized information;
 - Access to institutions and public goods.
- Arıç [7] states that there are four main reasons why a group of firms start or join a cluster:
- Networking;
 - Political and social benefits;
 - Commercial and strategic alliances;
 - Innovation.

Clusters are effective environments for information exchange [14]. Conferences, seminars, invited discussions, expositions are good opportunities for networking and sharing of information, expertise, and lessons learned. Therefore, effective clusters are also sources of innovation and place a special emphasis on such events. Today, clusters and innovation have become terms commonly used together. The Silicon Valley located in San Jose, USA, is a good example of a cluster as a source of innovation.

4. DEFENSE INDUSTRY CLUSTERS

The firms in the defense industry have certain roles depending on their size, products, and services. There are three main roles: Main contractor, subcontractor, and service providers or suppliers of various equipment and components. There are also some firms specialized in certain areas that conduct analysis, design, testing.

Figure 2 shows the hierarchical structure of the defense industry firms and institutions depending on their roles [1].

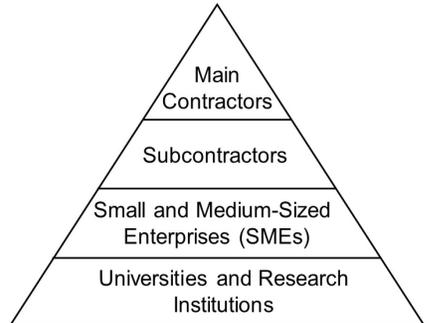


Fig. no. 2. Hierarchy of Dependence in Defense Industry

Due to security and confidentiality of the defense technology in defense systems, the need to develop these systems domestically, at least the critical portions of them is obvious. Many countries place limitations on the use of exported defense systems. For example, in USA, the export of defense systems is subject to the approval of the Congress. Furthermore, the maintenance costs of exported defense systems are considerably high. Therefore, independence in defense systems has many advantages for the countries. Defense systems are generally complex, large-scale, and software-intensive systems [19]. Normally, the defense contract is won by a main contractor. This main contractor has many subcontractors to develop various parts of the system. The main contractor may also get services for design, testing, and certification of specialized components. In some cases experts from consultancy firms or scientists from universities may be hired for consultancy. As a result, defense system projects have

many stakeholders [30]. Defense systems are normally developed for governments and stakeholder involvement is especially challenging in government-contract software projects [16]. Therefore, clustering has many benefits in developing defense systems by bringing these stakeholders together. To achieve competitiveness, the firms in the cluster should form effective collaboration circles both within the cluster and outside the cluster. The success of firms in the cluster is higher than the firms outside the cluster due to the fact that no firm can overcome all the challenges related to the development of defense systems. Since defense systems are large-scale and complex, it is quite unlikely that the expertise and resources needed to successfully develop a defense system will be possessed by only one firm. Thus, clustering is one of the best solutions to this problem. Porter emphasizes that clusters are formed by firms sharing common benefits and firms from different industries supporting the industrial focus of the cluster. The common benefits are shared pool of resources, institutions, a shared culture, common opportunities, and similar threats [6]. The strategic alliances between defense industry firms are affected by the political, social, economic, and security climate in the country.

The defense firms are not the only actors in creating a competitive defense industry. There are other actors playing significant roles in achieving a strong defense industry. These actors include the Ministry of Defense, government acquisition agencies, public and private research and development

institutions, universities, non-profit organizations. According to Ziylan, without government support a large defense project cannot be achieved by a single main contractor [2]. Having adequate qualified human resources in the defense industry is also important [4]. Therefore, universities and research institutions should be in close contact with clusters. These institutions should be able to offer programs and courses needed by this industry. Creating a synergy between all these actors will help to achieve a strong defense industry. The defense clusters should create communication channels with all these actors.

5. DEFENSE INDUSTRY CLUSTERS IN TURKEY

The fast growing defense industry started to realize the significance of clusters in achieving competitiveness. National policies and reports (see reference [17] as an example) also state that creating effective defense clusters is a necessity. To achieve competitiveness, defense industry should have a strong technological base and a sustainable growth in variety and depth. Murad Bayar, the Head of the Turkish Undersecretariat for Defense Industries (SSM) between 2004 and 2014, drew attention to the importance of defense industry clustering during his appointment. According to Bayar, the defense industry in Turkey has yet to reach the capability to create innovative and critical defense technologies. Bayar states that the development of capable contractors and subcontractors and the creation of necessary culture in defense industry take time. Consequently,

SSM is trying to lead the SMEs and other firms supporting the defense industry in establishing good defense project management practices and increasing the technological development capability. Bayar also highlights that clustering is an important tool in guiding these firms and achieving these goals. In this respect, Bayar gives the example of OSSA as a successful implementation of defense clustering [8].

As of 2015, there are 5 active defense industry clusters in Turkey. Another cluster is in development phase. Let's briefly introduce each cluster.

The first defense industry cluster in Turkey is **OSTIM Defence and Aviation Cluster (OSSA)** established in 2008 [20]. As an active cluster with 161 members, they conducted many projects including OSSA International Competition Project together with 24 participants [21]. They were the coordinator of ULTRAVEG Project with 8 companies and universities across Europe, within the scope of the 7th Framework Program of the European Union. They have taken part in aerospace projects by providing various parts and equipment to F-16 and CN-235 planes. In addition, they are producing industrial equipment such as "Turning and Milling Cutting Tools".

Teknokent (Technology Park) Defense Industry Cluster (TSSK) [22] located in Middle East Technical University in Ankara is established at the end of 2010. The cluster naturally has ties to the Middle East Technical University. The mission of the TSKK is "to provide added value to generate more synergy and cooperation among its members, with universities for applied research

in defense sector, and with major contractors” [22]. This cluster is a designated defense industry research and technology development region (SATGEB). Being in a SATGEB has incentives for conducting defense R&D. As a result, companies focusing on R&D have considerable advantages including tax reductions and funds for defense technology research. Naturally, this cluster has a strong R&D focus.

The Aerospace Clustering Association (ACA) [24] was established in 2010 in İzmir region. ACA is the first cluster specializing in aviation and space technologies with the purpose of pursuing the efforts for training qualified personnel. This association follows the guidance of the Undersecretariat for Defence Industries (SSM) in supporting the SMEs located in the Aegean Region. The cluster aims for projects with high added value. ACA is a member of the European Aerospace Cluster Partnership (EACP) that provides “a permanent platform for mutual exchange, policy learning, and cooperation to achieve high-level performance among European aerospace clusters” [32].

The Eskisehir Aviation Cluster (ESAC) [25] followed ACA in aviation. The cluster was established in 2011 in Eskisehir region. The location of this cluster is carefully chosen. It is located in one of the cities hosting a large Air Force base in Turkey. As a result, the companies in this cluster are expected to support this air force base with certain spare parts and specialized services. Musubeyli [33] lists the chronological events leading to the establishment of Eskisehir Aviation

Cluster. According to his study, the establishment of this cluster took more than 3 years. ESAC is also a member of the European Aerospace Cluster Partnership.

The Defence, Aviation, Space Clustering Association (SAHA) is established in 2015 in Istanbul region. It currently has more than 30 member companies and it is growing quickly with the advantage of being in Istanbul. Like many clusters, this site has a tax reduction for companies conducting research and development (R&D). There are also offices of big defense companies in this cluster. One of the main advantages of this cluster is the availability of skillful and well-educated human resources. Istanbul region has more than 30 universities and living in Istanbul is attractive for many engineering graduates.

The Space, Aviation, and Defence Cluster is established in 2014 in Bursa region. It has a strong support from the Bursa Chamber of Commerce and Industry. The stated goals of this cluster are:

- to meet the common necessities of its members,
- to facilitate the professional activities,
- to provide the development of the professions in accordance with its general benefit,
- to launch the clustering initiatives,
- to carry out activities to maintain the initiatives,
- to coordinate big scale projects,
- to ensure the regional development agency-supported projects.

This defense industry cluster is still under development. Currently, the cluster management board is trying to establish ties with domestic and international partners.

Table 4 shows the overview of the defense clusters in Turkey. The cluster in Bursa is not included in the table

since it is still under development. Figure 3 shows the locations of the defense industry clusters in Turkey.

Table 4. Defense Industry Clusters in Turkey

Cluster Name	OSTIM Defense and Aviation	Teknokent Defence Industry Cluster	Aerospace Clustering Association	Eskişehir Aviation Cluster	Defence, Aviation, Space Clustering Association
Cluster Abbreviation	OSSA	TSSK	ACA	ESAC	SAHA Istanbul
Cluster Focus	Defense and Aviation	Defense and Security	Aviation and Space	Aviation	Defence, Aviation and Space
Location	Ankara	Ankara	Izmir	Eskisehir	Istanbul
Year Established	2008	2010	2010	2011	2015
Number of Companies and Corporates	160 (7500 personnel)	70	37 Corporate 14 Academic 31 Companies (Over 60 members)	32	30+



Fig. no. 3. The Locations of Defense Industry Clusters in Turkey

6. CONCLUSIONS AND FUTURE WORK

The main characteristic of the first three defense industry clusters in Turkey is that these clusters are

mostly composed of SMEs. However, when we analyze the defense industry clusters in countries with strong national defense industries, we observe that defense clusters have a certain mix of SMEs and large-scale

defense companies. For example, the cluster Aviation and Space Valley of France, consists of not just SMEs but also main defense contractors. Naturally, these clusters are a better environment for creating synergy between SMEs and large-scale defense companies. We believe that to maximize the output of defense clusters in Turkey, the clusters should aim for a balanced mix of large-scale defense companies and SMEs.

The lack of guidance and determination of roles in defense clustering presents a challenge in Turkey. Without an in-depth analysis and planning, there are various attempts from different government agencies for clustering initiatives. While the government support is strong, lack of a coherent strategic plan for defense clustering may result in the suboptimal use of resources. One of the first steps in finding a solution to the current set of problems is to fill the gaps in the industry regulations related to clustering and cluster development.

The defense industry clusters in Turkey are in their early phases and they are not developed to the point of fully functioning clusters. The slow pace in the development may be attributed to the deficiencies in the cluster formation during early phases. Currently, the defense clusters in Turkey are only able to bring the SMEs together to increase coordination and the governing bodies of these clusters only act as an association to provide a list of subcontractors to the main contractors. The main reason is the perspective of the SMEs forming the clusters. Rather than cooperating and forming strategic alliances with other SMEs to increase their capabilities,

they mainly try to get their share of business and benefit from government subsidies such as tax deductions. The cluster management boards should find ways to increase the cooperation between cluster members. A cluster's strength lies in the amount of cooperation between its members and outside partners. Currently, the outside links of defense clusters is weak, especially the ones between the defense firms in clusters and universities [31]. While the Teknokent Defense Industry cluster located in Middle East Technical University in Ankara and Aviation and Space cluster located in İzmir, have strategic alliances with the universities located nearby, other clusters need improvement in this area. The universities should be more engaged in defense industry clusters and they should actively participate in defense project developments. Furthermore, clusters should put more effort in establishing partnerships with universities since the latter are also a source of skillful and educated human resources. Therefore, close ties between education institutions and defense clusters are very important in terms of developing the necessary human resources for the defense industry [29].

The defense industry clusters in Turkey have not specialized in a particular defense area or a technology. Specialization in certain defense areas may produce better results. For example, the French aviation and space industry clustering established in Midi-Pyrenees and Aquitaine region of south-eastern France is specialized in structural aviation engineering. The French aviation and space industry clustering established

in Ile De France, northern France, is specialized in aviation electronics and aircraft engines. Another cluster located in French Riviera (Côte d'Azur) region of south-eastern France develops projects related to helicopters. Therefore, the Turkish defense industry clusters should start focusing on specialization.

One of the main problems of SMEs in aviation clusters is financing problems [31]. Even though there is some government support and incentives, more support is needed to increase the competitiveness in the international arena.

Even though there are many problems, the defense industry clustering in Turkey is improving. The national defense industry capability and the variety in defense products will increase as these clusters continues to develop.

REFERENCES

- [1] Aktas, B. (2014). Defense Acquisition System (Savunma Tedarik Sistemi - In Turkish), Industrial Day Congress. Presentation of the Undersecretariat for Defence Industries, Konya, Turkey, 9-10 June 2014.
- [2] Ziylan, A. (2004). National Technological Capability and Defense Industry (Ulusal Teknoloji Yeteneği ve Savunma Sanayii - In Turkish). Savunma Sanayicileri Derneği Yayını, 2004 (1), p. 91.
- [3] Timurçin, D. (2001). The Notion of Clustering and Its Effect on Competitiveness of SMEs (Kümelene Kavramı ve KOBİ'lerde Rekabet Gücüne Etkisi - In Turkish). Çankaya University Journal of Humanities and Social Sciences, May 2011, 8(1), pp. 21-56.
- [4] Caymaz, E., & Erenel, F. (2012). Addressing the Need of Qualified Personnel in Defense Industry: The Turkish Case. The 7th International Scientific Conference "Defense Resources Management in the 21st Century", Braşov, November 15, 2012. pp. 25-29.
- [5] Kuah, A. T. (2002). Cluster Theory and Practice: Advantages for the small business locating in a vibrant cluster. *Journal of Research in Marketing and Entrepreneurship*, 4(3), pp. 206-228.
- [6] Akdeve, E. (2012). Defense Industry Clustering: Cooperation and Competition (Savunma Sanayii Kümeleneşmesi: İşbirliği ve Rekabet - In Turkish), Savunma Sanayii Gündemi, 2012, No: 19, pp. 69-74.
- [7] Arıç, K. H. (2011). Clustering Policy on Developing National and International Competitiveness: Research on Furniture Industry in Kayseri (Ulusal ve Uluslararası Rekabetin Geliştirilmesinde Kümeleneşme Politikası: Kayseri Mobilya Sektöründe Bir Uygulama), Doctoral Dissertation. Erciyes Üniversitesi Social Sciences Institute, Erciyes University, Kayseri, Turkey. 2011. pp. 132-137.
- [8] Bayar, M. (2014). National Defense Industry and Clustering Model (Ülkemiz Savunma Sanayii ve Kümeleneşme Modeli - In Turkish), Yatırım Finansman ve Dış Ticaret Dergisi, July 2014, p. 18.
- [9] Porter, M. E. (1990). The Competitive Advantage of Nations. *Harvard Business Review*, 68(2), March-April 1990, pp. 73-93.
- [10] Porter, M. (1998). Clusters and the New Economics of Competition, *Harvard Business Review*, November-December 1998, p. 78.
- [11] Demir, K. A., Sulukan, E., Deliorman, R. B., Demir, S., & Uyar, T. S. (2010). Competitive advantage of wind power industry for Turkey: Analysis of factor conditions in Porter's diamond model. In 9th World Wind Energy Conference & Renewable Energy Exhibition, Istanbul, June 2010. pp. 15-17.
- [12] Aluftekin, N., Yuksel, O., Tas, A., Cakar, G., & Bayraktar, F. (2012). Clustering Model in the Way-Out From Global Crisis: Textile and Apparel Sector Case Study (Küresel krizden çıkışta kümeleneşme modeli: tekstil ve hazır giyim sektörü örneği - In Turkish) *Uluslararası Yönetim İktisat ve İşletme Dergisi*, 5(10), pp. 1-19.
- [13] Jacobs, D., & De Man, A.P. (1995). Clusters, industriebeleid en ondernemingsstrategie, *Economisch Statistische Berichten*, 22-2-1995.
- [14] Sölvell, Ö., Lindqvist, G., Ketels, C., & Porter, M. E. (2003). The cluster initiative greenbook. Bromma tryck AB print,

Stockholm, First Edition, August 2003, pp. 27-28.

[15] Wisniewski, R. (2012). Defence Industry in the European Union Challenges and Opportunities in Times of Economic Crisis, *Przegląd Strategiczny*, 2012, nr 2, pp. 95-113.

[16] Demir, K. A. (2009). A Survey on Challenges of Software Project Management. In *Software Engineering Research and Practice 2009*, pp. 579-585.

[17] Undersecretariat of Defense Industries (Savunma Sanayii Müsteşarlığı (SSM) – In Turkish), 2012-2016 Undersecretariat of Defense Industries Strategic Plan, Ankara, Aralık 2011, s.12.

[18] Rosenfeld, S. A. (2002). Creating Smart Systems - A Guide to Cluster Strategies in Less Favoured Regions, *European Union-Regional Innovation Strategies*, April 2002, p. 6.

[19] Demir, K. A. (2009). Challenges of weapon systems software development. *Journal of Naval Science and Engineering*, 2009, 5(3), pp. 104-116. (Deniz Bilimleri ve Mühendisliği Dergisi, in Turkish)

[20] <http://www.ostimsavunma.org/en/content/about-us/286> , accessed on October 10, 2015.

[21] <http://www.ostimsavunma.org/en/content/activities/720>, accessed on January 14, 2016.

[22] <http://tssk.oduteknokent.com.tr/>, accessed on October 10, 2015.

[23] Verbeek, H. (1999). Innovative Clusters: Identification of value-adding production chains and their networks of innovation, an international studies. Doctoral Dissertation, August 1999, Erasmus University Rotterdam, Netherlands.

[24] <http://www.hukd.org.tr/En/> , accessed on October 10, 2015.

[25] <http://www.esac.org.tr/?lang=en>, accessed on October 10, 2015.

[26] Erenel, F, Demir, K. A., Caymaz, E. (2015). Assessment of Defense Industry Clusters in Turkey, In the 10th International Scientific Conference “Defense Resources Management in the 21st Century”, November 13th 2015, Braşov, Romania. pp. 101-107.

[27] <http://www.sasad.org.tr/uploaded//SASAD-DEFENCE-DIRECTORY-2015.pdf> , accessed on 10 February, 2016.

[28] <http://www.sasad.org.tr/uploaded//2014-Yili-Savunma-ve-Havacilik-Sanayii-Performans-Raporu.pdf>, accessed on 10 February, 2016.

[29] Yalçınkaya, A., and Adiloglu, L. (2014). The Concept of Aerospace Clustering and The Case of Eskişehir Aerospace Cluster (Havacılıkta Kümelene Anlayışı ve Eskişehir Havacılık Kümelene Örneği – In Turkish). *The Journal of Business Science*, 2(1), 91-110. (İşletme Bilimi Dergisi – In Turkish).

[30] Demir, K. A. (2005). Analysis of TLCharts for weapon systems software development. Masters’ Thesis, Naval Postgraduate School Monterey, CA, USA.

[31] Gebes, F, & Battal, U. (2014). Aviation Cluster in Turkey and Financing Problems (Türkiye’de Havacılık Kümelene ve Finansman Sorunları – In Turkish). *Niğde Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*, 7(1), p. 273.

[32] http://www.eacp-aero.eu/index.php?id=1&no_cache=1, accessed on February 10, 2016.

[33] Musubeyli, S. (2011.) Aviation Clustering in Eskişehir (Eskişehir’de Havacılık Kümelene – In Turkish), VI. Ulusal Uçak, Havacılık ve Uzay Mühendisliği Kurultayı, 6-7 May 2011, Eskişehir, Turkey.

ACKNOWLEDGMENTS AND DISCLAIMERS

The authors take full responsibility for the contents and scientific correctness of the paper. The views and conclusions contained herein are those of the authors and should not be interpreted as necessarily representing the official policies or endorsements, either expressed or implied, of any affiliated organization or government. This article is a modified and extended version of the study [26] presented in the 10th International Scientific Conference “Defense Resources Management in the 21st Century”, November 13th 2015, Brasov, Romania.