Cooperation Forms in the Aeronautics Industry

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Abstract: The development of the world economy and the globally accelerated diversification of production led to the need of widening the economic cooperation. The need of cooperation increased in various sectors of the global economy, such as the transport industry, IT and commercial sector. The aeronautics industry is a representative sector of cooperation, where the exchange of knowledge and technology, the cooperation between universities, industries, research organizations, small and medium enterprises (SMEs), etc. and the free flow of ideas are crucial factors for the implementation and sustainability of a unique innovation system. The main objective of this paper is to identify the main forms of cooperation in the aircraft industry. The paper includes two important parts: the first part contains an analysis of the US and Europe aeronautics industry evolution, highlighting the cooperation forms and fields that emerged over time; and the second part comprises an analysis of the Romanian aircraft industry cooperation.

Key Words: Cooperation, aeronautic industry, market structure, Firm strategy

1. INTRODUCTION

The development of the world economy and the globally accelerated diversification of production led to the need to broaden the economic cooperation. Cooperation was the first included as a fundamental principle of contemporary international law, in the “United Nations Charter” from 1945, being considered a new principle of solving the major problems of contemporaneity.

This is broadly defined by R. F. Godinec “as an international relations way that involve the beginning of the implementation of strategies, policies, tactics followed for a period of time and designed to be more private, thanks to permanent mechanisms, the international relations in one or more defined fields without putting into question the independence of the units referred to”[1].

The necessity of cooperation increased in various sectors of the global economy, such as the transport industry, IT and commercial sector. The aeronautics industry is a representative sector of cooperation where the supply chain of the Original Equipment Manufacturers (OEM) comprises thousands of smaller companies and research organizations. They perform an essential role in a high-tech sector, in which the development of
innovative technological products is crucial in order to achieve a decisive breakthrough. In this regard, cooperation with suppliers, in particular in the innovation process, can prove to be effective for the Original Equipment Manufacturers (OEM), in order to obtain lower costs and effective operating time [2].

In the recent decades, in the European Union (EU), a rich variety of policies, measures and programs, was introduced in order to stimulate the innovation potential of the European organizations in many fields, including the aeronautics industry.

Today, the European aeronautics knowledge sharing and technology cooperation between universities, industry, research organizations, small and medium enterprises (SMEs), etc. and the free flow of ideas are considered crucial for the implementation and sustainability of a unique innovation system. Some of the key factors were highlighted in the European Advisory Group Report for the Aerospace Industry Strategy for the 21st Century ‘(STAR 21) dated July, 2002 [3], * STAR 21, namely:

- The strong connection between civil and defense activities,
- The cyclical nature of the industry,
- The high level of capital intensity,
- Consolidation,
- Privatization,
- The EU-US relations.

The European aeronautics industry tends to be naturally dominated by a few prime contractors such as Airbus, Dassault Aviation, GKN, Rolls Royce, Snecma, and Thales. Airbus Group is the European operating company in all segments of the aeronautics industry market. The Commission acknowledged that the European aeronautics industry is too fragmented to face international competition and the restructuring of this field is going to slow. Therefore, it was necessary to take accompanying measures in the European Research Framework Programme for the application of public procurement rules, the adoption of a European company statute and a uniform certification by the European Civil Aviation Authority and European standardization.

The main objective of this paper is to identify the main forms of cooperation in the aircraft industry.

The paper includes two important parts: the first part contains an analysis of the US and Europe aeronautics industry evolution, highlighting the cooperation forms and fields that emerged over time; and the second part comprises an analysis of the Romanian aircraft industry cooperation.

2. COOPERATION IN THE AERONAUTICS INDUSTRY

The global aeronautics industry integrates supplier networks, which are located mainly in North America, Asia and Europe.

The aircraft industry was often marked by national and international collaborations and partnerships. Such internationally cooperation were required by the dispersed nature of the manufacturing cost-effectiveness and by the research and development capabilities of the suppliers. Most of the companies provide products or components within several segments of the aeronautics industry.

This is particularly frequent in the aircraft manufacturing and it is due to many common things of the military and civilian aircraft technologies. Aircraft segment is the largest segment of the aerospace industry in both the USA and Europe. The aeronautics segment is divided in two categories: civil and military.
The United States of America (USA) is one of the main developers of the aerospace and one of the leaders of the aircraft industry global market.

The changes occurred on the USA aeronautics industry market in the last half century affected the industry from both structural and organizational points of view. The collaborations and mergers over time between companies, and the technological innovations that they have bequeathed contributed to the US industry consolidation.

This was mainly due to both economic and political environment, and taking into account the customer needs.

Since the early 1970s the United States have started to lose their competitive edge, when several countries from Europe have created a consortium that was later transformed into a European company named the Airbus Group.

Analyzing the history of the US supply chain, we highlighted the periods that led to changes in the organizational structure of the industry and the emergence of various forms of cooperation. The table below highlights the outstanding periods in the USA aircraft industry.

Table 1. Cooperation forms in the US aeronautics sector

<table>
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<tr>
<th>Period</th>
<th>Cooperation Forms</th>
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<tr>
<td>The 50’s</td>
<td>- Development of the first electronic devices, such as radar &amp; fire control,</td>
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<td>- Development of the aerospace market: space and strategic missiles,</td>
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<td></td>
<td>- The market entry of non-aerospace companies (E.g. General Electric) whose requirements are suitable for the existing capacities,</td>
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<td></td>
<td>- Beginning of the multi-tiered supply chain in the aviation industry: E.g. the primes who delivered the finished product and their “top tier” partners who provided essential subsystems.</td>
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<tr>
<td>The late 60’s and the early 70’s</td>
<td>- Mergers between aircraft manufacturing companies,</td>
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<td>- Outsourcing the production to strategic partners.</td>
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<td>The 80’s</td>
<td>- Emergence of new industries with synergies to aerospace technologies,</td>
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<td>- For example McDonnell Douglas started a pharmaceuticals business in the anticipation of the development of zero-gravity medicines aboard the Space Shuttle. The Martin Marietta Company combined its expertise in aerospace materials with the production of aluminum, construction materials, and chemicals.</td>
</tr>
<tr>
<td>The 90’s</td>
<td>- Dramatic decline in military expenditures,</td>
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<td>- Horizontal consolidation of the former competitors. Boeing merged with McDonnell Douglas, Lockheed merged with Martin Marietta, Northrop Grumman merged with Raytheon E-Systems, among many others.</td>
</tr>
<tr>
<td>At present</td>
<td>- Few prime contractors remain in each industry segment; Commercial Aircraft: Boeing; Military segment: Boeing or Lockheed Martin; Space Systems are again available only from Lockheed or Boeing.</td>
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Europe had also a significant contribution in the first part of the development of this market. Great Britain was focused on manufacturing BAC1-11 and Trident among other projects. France produced Caravelle.

Together, the Great Britain and France built the first supersonic passenger plane in the world, Concorde.

But the production and the operating costs proved to be extremely high [5]. However, the aeronautic industry has been marked by two important periods:

- Pioneering Age - the period that included the beginning of powered flight to the jet airliner.
- Commercial Era – marked by the air traffic growth [6]. This was a period in which major progresses have been made in terms of speed and aircraft ranges and also in terms of reducing noise and fuel consumption, as seen in Figure 1.
The European company Airbus had as a basic strategy the creation of partnerships and industrial cooperation with major companies from worldwide.

Each aircraft development program had a different structure of the supply chain. This has led towards various forms of cooperation. The merger between Aerolia and Sogerma in Stelia Company could be such an example.

The merger of the two companies had a significant economic impact, Stelia became the third company that manufactures aerostructures on the global level and an European market leader (news Industry, 2014).

The creation of industrial partnerships, is an effective way of managing commercial, financial and administrative contracts with the major producers. Table 2 highlights some cooperation forms.

Table 2. Cooperation Forms in the European aeronautical sector

<table>
<thead>
<tr>
<th>Mergers between companies from the aeronautics industry</th>
<th>E.g. The merger of the Aerolia and Sogerma companies in Stelia.</th>
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<tbody>
<tr>
<td>Industrial partnerships</td>
<td>Ex. BELAIRBUS, industrial partnership formed by the Sonaca, ASCO and EURAIR companies ; Airbus Helicopters Romania-joint venture created by Airbus Helicopters and IAR SA.</td>
</tr>
<tr>
<td>Geographical localization</td>
<td>Aerolia company created local units near to Airbus sites in Toulouse, Méaulte, Saint-Nazaire and Hamburg.</td>
</tr>
<tr>
<td>ACARE – Advisory Council for Aeronautical Research in Europe</td>
<td>The Group set up by the European Commission which includes representatives of the Aeronautics Industry.</td>
</tr>
<tr>
<td>EREA - Association of European Research Establishments in Aeronautics</td>
<td>EREA - includes 14 european research institutes from the aerospace industry.</td>
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<tr>
<td>IFAR - International Forum for Aviation Research</td>
<td>IFAR- includes 26 aviation research organizations, including universities activating in aviation research.</td>
</tr>
<tr>
<td>European Research Programs</td>
<td>Horizon 2020- the latest European research program, with a budget of almost 80 billion euros, covering the period 2014-2020.</td>
</tr>
<tr>
<td>Clean Sky Joint Technology Initiative</td>
<td>Involves 12 founding companies from aeronautics industry and 86 organizations from 16 countries.</td>
</tr>
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In terms of research in the aircraft industry, the European vision of the developments in the aeronautic sector had as main representative ACARE – Advisory Council for Aeronautical Research in Europe, the group set up by the European Commission which comprise representatives from aeronautics industry.

This represented the first step for further development of the Strategic Research and Innovation Agenda (SRI, 2002) and other strategic documents of the aeronautics industry. Also, organizations and forums organizations were created for enhancing the cooperation in the aeronautics industry. In this respect we could mention EREA – Association of European Research Establishments in Aeronautics and IFAR- International Forum for Aviation Research who participate on the preparation of the programmatic documents, vision and strategies regarding the European and global aeronautics aiming to increase cooperation between the organizations they belong to.

The Framework - Programs 5, 6, 7 and now the Horizon 2020 program of the European Community for Research and Technology Development, had as main objective the the research promotion and funding.

Also, the Joint Initiatives Technology has been created by the European Commission under the Framework Program 7 (FP7) to allow the achieving of ambitious and complex research objectives. The discussions have started between the European Industry and research establishments since 2004 [7].

The research programs are designed primarily to stimulate cooperation between different actors in the field of research in order to implement the technology and knowledge for the benefit European society. This enables a more effective response on the challenges of social, economic, environmental and industrial present and future. Thus, research is an important factor of cooperation between universities, industries, research centers and public bodies makers, both within the European Union (EU) and worldwide.

3. COOPERATION FORMS IN ROMANIAN AERONAUTICS INDUSTRY

The development of the Romanian aeronautics industry started between 1920 and 1940 and followed a worldwide continuous progress in this field. The Creativity of personalities with inventive spirit, such as Traian Vuia (first complete flight with onboard means in 1906), Henri Coandă (first jet engine used for propulsion in Aviation, 1910), Aurel Vlaicu (an original and inventive high performance airplane, 1910), Hermann Oberth, led to fundamental achievements both in technique and art of flight as well as in aircraft engineering. In that time the industry was oriented towards the production of aircraft and engine manufactured both under the license or the design of national defense-related companies, such as Arsenalul Aeronautic, SET and ICAR in Bucharest, STC in Constanța, ASTRA in Arad, Schiell and IAR in Brașov [8].

The development of the Romanian aeronautics industry was intensified after 1968, including the research and development field. Major programs for research, development and manufacturing of aircraft, motors and aeronautics equipment were initiated between 1968 and 1989. Investments were made in order to create new facilities in Bucharest, Brasov and Craiova and to develop the existing ones. At that time in the Romanian aeronautics sector were working about 35,000 people, of which 2,500 activated in research institutes [9].

Starting with the 90’s, the former enterprises became commercial companies. Meanwhile, some of them were privatized. The companies had to reorient their development strategies in a market economy were they encountered plenty of mental and technical obstacles.
Also, due to the decreasing number of internal and external orders for the aeronautics products and services and to reconsideration or interruption of certain programs, the companies from the aeronautical sector have been forced to drastically reduce the number of their employees.

Today, in Romania activates traditional companies with expertise in the aeronautics industry as well as research and development organizations, with significant activities in the aerospace industry. These are highlighted in Table 3.

Table 3. The main Romanian organizations that activates in the aeronautics sector

<table>
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<tr>
<th>Main Romanian Companies with expertise in Aircraft Industry</th>
<th>R&amp;D Institution with expertise in Aircraft Industry</th>
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Other companies or research institutions with direct or indirect experience in the aerospace industry also contributes on the development of this sector. These include: Military Technical Academy, Centre for Advanced Studies Professional Association – INCAS, National Research and Design Institute for Electrotechnics – ICPE CA, National R&D Institute for Textile and Leather – INCET, National R&D Institute for Fine Mechanics – CEFIN, Institute for System Analysis – INAS SA, IAROM SA, Fokker, Atexis, Honeywell. These organizations are actively involved in major research and development projects, in collaboration with various partners from aeronautical sector.

Following the international trend of the aeronautics market, the cooperation represents one of the most important factors for the Romanian aeronautics industry progress. The Romanian companies and the institutions that activates in this field have created both nationally and internationally partnerships.

Also, few of them have been integrated and activates into the various international organizations established in the aeronautics industry. Table 4 highlights some of the main forms of cooperation.

Table 4. Cooperation Forms in the Romanian aeronautics sector

<table>
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<tr>
<th>Industrial Partnerships</th>
<th>Ex. The establishment of the FOAR company - Aerostar owns 51% shares and 49% Fokker. Airbus Helicopters Romania- a joint venture created by Airbus Helicopters and IAR SA.</th>
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An example of cooperation is the establishment of the Foar ente enterprise, were the Romanian company Aerostar owns 51% of shares and the Dutch company Fokker 49%. The company was designed to create components for the Airbus A300 aircraft family as well as European rocket Arianne 5 and then for airplanes Dassault 7FX. Aerostar SA was the only manufacturer of these parts [10].

Aerostar SA also started the collaboration with Fokker Aeroconstructs under a project funded by the Dutch government [11].

To improve their responsiveness and diversification, the international companies from aeronautics industry have opened subsidiaries, located close to the traditional Romanian manufacturers. An example is County Brasov, where IAR Brasov is a traditional manufacturer.

The activity of the company was oriented towards the production of civil and military helicopters (IAR 316 Alouette III, IAR 330L Puma), and has developed a close technical cooperation with French companies that are focused on light and leisure aircraft production. Therefore, Airbus Helicopters Romania, the manufacturer helicopters division of the

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<tr>
<td>Geographical localization</td>
<td>Brașov county: IAR Brașov; Airbus Helicopters România; Premium AEROTEC; BWB Surface Technology SRL; Hutchinson SRL; Aeranova European Components SRL</td>
</tr>
<tr>
<td>EREA – Association of European Research Establishments in Aeronautics</td>
<td>Member: INCAS – National Institute for Aerospace Research “Elie Carafoli”.</td>
</tr>
<tr>
<td>European Research Programs</td>
<td>FP7 and Horizon 2020 Participants in the projects: INCAS – National Institute for Aerospace Research “Elie Carafoli”; STRAERO SA; National Research and Development Institute for Gas Turbines – COMOTI, etc.</td>
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</table>
European concern Airbus Group, in which IAR Brasov has a minority shareholding (49%) was created in 2002.

In the last 10 years the subsidiary Airbus Helicopters Romania has expanded both in terms of turnover and the number of employees [12].

The number of international companies that activates in the aeronautics industry is constantly increasing. In 2010 Premium AEROTECH – German division of the European company Airbus Group opened a new factory that manufacture and assemble components for Airbus ranges aircraft (A320, A330 / 340, A380).

The upcoming of Premium AEROTECH Company in Brasov, has attracted a new investor, namely BWB Surface Technology SRL company which started operations at Ghimbav [13].

Also, others Airbus suppliers companies such as Aernnova and Hutchinson Company operate in Brasov.

Regarding the research field, Romania aims to harmonize its development policies research, innovation and technology with the European politics in order to ensure the connection between technical and scientific community objectives and also between the Romanian business environment and specific scientific and technological priorities of the European Union.

Also, following the accession of Romania to the European Union, its participation in Research Framework programs for Aeronautics increased both in the number of participating organizations and the number of projects.

So the number of the participants has increased from 4 (the number of organisations participating with 8 projects in the FP5) to 13 (the number of organisations participating with 39 projects in FP7).

The considerable growth represents a reflection of the importance and the priorities established by the Romanian research organizations, in order to participate at the European programs, strategies and visions that support the integration and participation of the Eastern Europe countries at the aeronautics research programs.

Therefore in the European Framework Programmes, research and technological development projects were signed with major partners from aeronautics, such as DLR, ONERA, NLR, CIRA, INTA, FOI, VZLU, ILOT that led to partnerships for future collaboration in international research consortia.

“Clean Sky“ Joint Technology Initiative - launched under the FP7 (2008) represents an opportunity of cooperation between universities, industries, research centers and public bodies within the European Union.

The basic participation is in the Integrated Technology Demonstrator (ITD) called SFWA - Smart Fixed Wing Aircraft, alongside with EU industry represented by Airbus, Saab and Dassault, as well as the European research centers, represented by DLR, ONERA and NLR. At ITD SFWA - Smart Fixed Wing AIRCRAFT.

Romania participates as a joint consortium between two research institutes: INCAS and STRAERO and two industry players: ROMAERO and AVIOANE Craiova [14]. This consortium was selected to participate in the Integrated Technologic demonstrator (ITD) within the CLEAN SKY program as a founding member of the Clean Sky JU and as associated partner.

Romania is the only country from Central and Eastern Europe participating as a member of JTI – CS. This participation allows a great technological leap at the industry level, where research has the opportunity to implement technologies that are at different levels of maturity.
Therefore, by Clean Sky program and by the European Framework projects as AFLONEXT and ATLLAS, the institute participates in the development of new technologies for the aeronautics field (Incas Activity Report, 2015).

Currently, the newest research program at European level is Horizon 2020 which has a budget of almost 80 billion euros and covers the period 2014-2020.

In Romania, the most representative national research programs are The National Research, Development and Innovation 2015-2020 – PNCDI III, the Core Program and the Sector Programme.

Highlighting the previous aspects we can conclude that in the aeronautics field the share of knowledge and technology, the cooperation between universities, industry, research organizations, small and medium enterprises (SMEs), etc. are necessary elements for the implementation and sustainability of a unique innovation system.

4. CONCLUSIONS

Similarly to the European and US developments, in the Romanian aeronautics sector can be noticed the following trends:
- The Romanian aeronautics sector, is taking part in the main internationally events at both research and industry level. These participations highlight the significant progress in research and the high degree of integration of the aeronautics industry worldwide.
- The research programs are designed primarily to stimulate the cooperation between different actors from the research field in order to implement the technology and knowledge to the benefit of European society
- The Romanian aeronautics industry sector continues the privatization / reorientation of the companies, both in terms of strategy and organization and the tendency is that this process will continue in the future.
- Integration of the companies in the aviation industry in the global structures of the worldwide aerospace industry.

The future of the aviation industry depends largely on the cooperation, because it involves the allocation of a high volume of human and financial resources, impossible to be mobilized by each country on its own.

In Romania, the development of this sector is related to expanding cooperation with international companies.

Competitive advantage comes from increased specialization and the development of the aeronautics industry subdomains such as: manufacture of landing gears, wheels and brakes, manufacture of composites, manufacture of engines and engines components, manufacture of airframes and components etc.

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