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**MULTIFACETED NATURE
OF COOPETITION INSIDE
AN AVIATION SUPPLY CHAIN
– THE CASE OF THE AVIATION VALLEY**

Abstract

In recent years the concept of coopetition becomes more and more popular in both economy and literature. The growing interest in coopetition strategies, their characteristics and adaptation stems from the fact that it may be perceived as a significant factor for leveraging effectiveness and performance of modern organizations.

Drawn from existing literature this paper attempts to present the character of coopetition inside the aviation supply chain. By identifying different levels, scopes and fields of both cooperation and competition four types of coopetition were identified. In the light of the obtained results particular members of considered supply chain may be characterized by: national coopetition, global coopetition, hybrid coopetition and multidimensional coopetition. The identified types of coopetition are varied in terms of: a) the market scope of coopetition, b) types organizations engaged (i.e. subsidiaries / parent organizations), c) stages of supply chain maintaining coooperative relationships, and d) complexity and directedness of coopetition.

Keywords: *coopetition, cooperation, competition, networks, supply chain, aviation, case study.*

Introduction

Even though supply chains are not new phenomena, nowadays they are attracting greater and greater attention of researchers from management sciences (Wilhelm, 2011). The growing interest in supply chains within the management field may be justified by the fact that today in business practice supply chains as well as supply chain management are at the heart of successful business strategy (Houé and Guimaraes, 2013). In a traditional, management-based view supply chain is understood as a set of cooperating – in deferent aspects of activity – production, trading and service companies together with their clients among which the flows of products, information and money are realized (Witkowski, 2010). However, in more recent literature supply chains are perceived as a network of cooperating organizations engaged – through a set of relationships – in joint processes and activities creating values like products and services provided to the final clients (Christopher, 1998). Modern supply chains take the form of

network of companies, including suppliers and their suppliers, if they exist, and clients and their clients, if they exist (Lambert, 2008). Moreover, supply chains are co-created by a network of resources, materials, information and services (Chen and Paulraj, 2004) provided by all the above-mentioned organizations. To conclude, the newest view on supply chains assume that it is “a set of three or more entities directly involved in the upstream and downstream flow of products, services, finances, and information from a source to the customer” (Mentzner et al., 2001, p. 4) together with the dense network of diversified relationships among them.

The aim of this paper is to present and discuss the results of the research on cooperation conducted within a supply chain. The cooperation as well as cooperative relationships are explored from the perspective of the behaviors and strategies adopted by particular members of supply chain rooted in a Polish aviation industry. First, this research provides the diagnosis of cooperation features recognized among particular members of considered supply chain. Second, the research identifies the types of cooperation existing within the considered network of cooperation. The findings suggest that the particular members of supply chain are diverse in terms of cooperation strategies adopted.

This paper is divided into four parts. The first section outlines the theoretical underpinnings for the phenomena of cooperation and cooperative relationships in supply chains. The second part raises the methodological issues including research design and research methods. The third section presents the research results reflecting the cooperation phenomena inside one, purposefully chosen innovation network i.e. Aviation Valley. The findings are presented with a distinction into national cooperation, global cooperation, hybrid cooperation and multidimensional cooperation. Finally, the fourth section summarizes the outcomes of the conducted study, outlines the possible directions for further research, and points out the most important limitations of the research.

1. Theoretical background

In business practice, modern supply chains function as multifaceted and highly complex networks (Houé and Guimaraes, 2013). They consist of multitude of stakeholders (Houé and Guimaraes, 2013) and dense network of complicated, strong, long-term, and interdependent relationships among partners developed and fostered through strategic collaboration (Chen and Paulraj, 2004). Such a high level of complexity and diversity of links and organizations involved

causes that modern supply chain more often can be labelled as a multi-stage, multi-member, or multi-product (Sepehri and Fayazbakhsh, 2011). From the strategic management point of view it should be emphasized that supply chains are formed to achieve a greater level of sustainable competitive advantage for all parties involved (Cheng et al., 2008; Sepehri and Fayazbakhsh, 2011) what is attainable by combining individual strengths and unique resources of particular organizations through collaborative and dense relationships.

In the literature on supply chains and supply chain management, there is emphasized not only the existence but also the significance of beneficial collaborative relationships (Christopher, 2001; Houé and Guimaraes, 2013) among particular partners. However, besides these purely collaborative links, members of supply chains are connected by – more or less – competitive relations, or co-competitive ties. In other words, among supply chain members we are able to identify three different conditions, namely: cooperation, competition and co-competition. It is worth noting that while the prior literature expressed rather the first situation only the latest research points out that today “members of a supply chain more often compete fiercely” (Sepehri and Fayazbakhsh, 2011, p. 61). It shows indirectly, that between partners maintaining collaborative relations more often appear co-competition and co-competitive relationships (Wilhelm, 2011). Indeed, in supply chain firms more willingly and more often simultaneously compete and co-operate in order to maximize their profits (Gurnani et al., 2007) and competitive advantage reached. Therefore co-competition can be perceived as a one of the distinctive feature of modern supply chains (Li et al., 2011) while their members are characterized by an inherent tension of cooperation and competition (Wilhelm, 2011).

Furthermore, from the managerial perspective co-competition can be perceived as a factor of competitive advantage created by the whole supply chain as well as by its particular members (Li et al., 2011). This leveraging effect of co-competition for supply chain performance results from the development of many different cross-functional aspects of cooperation strengthening the cooperative intensity and influencing especially customer performance and financial performance (Luo et al., 2006). Moreover, the prior research on supply chains pointed out that co-competition among supply chain members provides greater results than their only competitive or collaborative approach (Sepehri and Fayazbakhsh, 2011). In other words the more co-competitive than only collaborative relationships within the supply chain the greater value and supply chain performance is reached.

Most of prior research on relationships conducted under the conditions of supply chains has been focused on collaborative ties and cooperative connections. Unfortunately, only very few studies were conducted on the coexistence of

the cooperation and competition relationships between supply chain members (e.g. Chen, Paulraj, 2004). To the authors' knowledge the cooperative relationships perceived in theoretical papers as so significant (Li et al., 2011; Sepehri and Fayazbakhsh, 2011; Wilhelm, 2011) remain poorly and fragmentally recognized (Cheng et al., 2008) contributing to the fact that our knowledge about cooperative relationships seems to be ambiguous, or even a little bit blurry. Firstly, previous research on cooperation among members of supply chains has investigated cooperation at the dyad level (i.e. cooperation has been considered between two organizations only – Gurnani et al., 2005) while the literature stresses that in case of cooperation inside supply chain we need a much wider, holistic approach considering cooperative relationship inside the whole network of ties and connections among – and not only between – members of supply chain (Wilhelm, 2011). Secondly, prior research related to the phenomena of cooperation inside supply chain was devoted to comparisons of the collaborative, competitive and cooperative behaviors of the supply chain members (Sepehri and Fayazbakhsh, 2011). Thirdly, the majority of prior research was explorative in nature (Gurnani et al., 2005; Lejeune and Yakova, 2005; Wilhelm, 2011; Sepehri and Fayazbakhsh, 2011) and only a slight research efforts were directed on explanation of the significance of cooperation for knowledge management and knowledge-intensive processes inside supply chains (e.g. Cheng et al., 2008; Li et al., 2011).

To conclude, prior literature does not provide research on the specifics and nature of the cooperative relationship in the strict sense, do not provide holistic perspective undertaken from the whole supply chain point of view. Generally the cooperation and cooperative relationships still remain poorly recognized under the conditions of supply chains (Cheng et al., 2008). Therefore, further and deeper, theoretical and empirical, exploratory and explanatory research in exploring cooperation and cooperative relationships is needed (Gurnani et al., 2005; Cheng et al., 2008; Wilhelm, 2011). Lack of comprehensive and holistic research on cooperation and cooperative relationships among members of supply chains as well as the limitations of prior research outlined above seem to justify the existence of the research gap. This gap ought to be filled in by exploratory and qualitative research (Houé and Guimaraes, 2013). Therefore the goal of this paper is to present and discuss the results of the research on cooperation relationships within one, purposefully chosen supply chain. The results are presented and discussed through investigation of most important characteristics, main types and different variants of the identified cooperative relationships among members of the networked supply chain.

2. Research design*

The Aviation Valley case aims at identifying the cooperation features and types related to the particular members of supply chain. Research on cooperation strategy and cooperative relationships was grounded in Polish aviation industry. The choice of this industry is justified by several reasons: highly developed inter-organizational cooperation (caused by strong pressure to constantly be innovative and tremendous level of expenditure on R&D), high level of networking, above-average level of complexity and modularity of products manufactured by Polish aviation companies, specificity favouring establishment of supply chains (aviation industry consists mainly of SME subcontractors and suppliers, there are only several large, key companies manufacturing final products like aviation engines). In Poland, there are more than 120 companies working for aviation industry, employing over 25 thousand employees. Most of Polish aviation companies are members of Aviation Valley (AV) which was chosen for our investigation. The Aviation Valley is a registered association of companies and organizations active in the field of aeronautical manufacturing, research, training or exploitation. It has been founded very recently, yet has proven since 2003 to be a very effective horizontally integrated supply chain implementing cutting edge aviation technologies and providing state of the art aviation products including aeronautic engines, gliders, light planes, and helicopters. Between its creation date in 2003, where 17 founding members laid grounds for a formal industry association and now a sharp increase in membership can be noticed – it is now topping 95 firms and organizations.

Since 2003, Aviation Valley functions as a cluster (as it is geographically concentrated), as an association (as it is registered as a NGO), as a supply chain (as it provide co-created and co-produced aviation engines, planes, gliders and other aviation products), as a chain in global value and supply chain (as it provides modular components for final producers like Boeing, Airbus, or Embraer). In 2013 there was more than 90 members, 23 500 employees and turnover exceeded 1 billion € – covering more than 80% of Polish aviation industry in terms of total employment and turnover. The size and obtained results locate Aviation

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Valley among the most important European aviation and aerospace clusters (Niosi and Zhegu, 2005). The Aviation Valley operates as a supply chain – especially – for three global aviation corporations: United Technology Corporation, Avio Group and Augusta Westland. The Aviation Valley is a cluster with three major geographical concentration areas: around the city of Rzeszów in south-eastern Poland; around the city of Bielsko-Biała in southern Poland; around the city of Świdnik in eastern part of Poland, the distances between these sub-clusters exceeding 250 km in each direction. It should be added that every one of sub-clusters operate around one large company being the subsidiary of above-mentioned global corporation. First, WSK Rzeszów owned by United Technology Corporation is the core for organizations operating around the city of Rzeszów. Second, Avio Polska owned by Avio Group is the core for organizations operating around the city of Bielsko-Biała. Third, PZL-Świdnik owned by Augusta Westland is the core for organizations operating around the city of Świdnik.

The investigation of the coopetition and cooperative relationships was restricted to a strategic alliance organized as a formal association as the literature states that coopetition can be identified and should be explored inside cooperative and formal supply chains (Sepehri and Fayazbakhsh, 2011). On the other hand, the restriction of research perspective to one, purposefully chosen supply chain can be justified by the qualitative, exploratory and explaining nature of the research aims, as well as by the existence of cognitive gaps and lack of previous research. Therefore, the research adopts a qualitative approach and applies an interpretative case study method (Stake, 2009) aiming at theory building (Andrade, 2009).

Research design aims at identifying key features of coopetition characteristic for Aviation Valley members. Therefore a three step approach has been adopted. Firstly, secondary data (including articles, annual industry reports, purchasing information, and websites) was collected in order to briefly describe cluster relevant members, and identify their business profiles. Secondly, in order to identify coopetitors the analysis of the area of competition and cooperation within the supply chain has been conducted. In general, among the supply chain members 27 coopetitors were identified. Thirdly, primary data was collected to distinguish the most important features of cooperative relationships maintained by identified coopetitors. In that part of the study 22 direct, semi-structured interviews were conducted. The owners, directors, vicepresidents and top managers played the role of our interlocutors. As an additional source of information the researchers run two observations during annual meetings of Aviation Valley members. It should be added that both, the primary and secondary data for the purposes of the research was collected between September 2010 and December 2011.

3. Coopetition within a supply chain – the case of Aviation Valley

Aviation Valley is the biggest, the oldest, the most developed formally registered supply chain in Polish aviation industry. Taking the perspective of its objectives and main characteristics it is an innovation network consisting of intensive, strong, and close cooperative and coopetitive relationships. Aviation industry – which creates the context for the activity of Aviation Valley – is knowledge intensive sector (Niosi and Zhegu, 2005), where innovations provide competitive advantage, and the processes of knowledge creation, knowledge acquiring, and knowledge sharing seems to be the overriding objectives (Broekel and Boschma, 2009; Dos Santos and Neto, 2009). Very often, the processes of searching new knowledge require external collaboration with customers, suppliers, science representatives and even with competitors (Niosi and Zhegu, 2005). Therefore the majority of collaborative initiatives, inter-organisational networks as well as formal and informal supply chains within aviation industry function as innovation networks inside which competition is accompanied by collaboration. Cooperation with competitors creates possibilities to improve quality, invent innovations (Hagberg-Andersson and Tidström, 2010), foster innovation and knowledge sharing (Osarenkhoe, 2010), and stimulate efficient knowledge management (Dos Santos and Neto, 2009). Furthermore, coopetition provides access to complementary resources (Luo and Slotegraaf, 2006) and to competitors' skills and capabilities (Gnyawali and Park, 2009) which would be otherwise unavailable. All of the above-mentioned benefits of simultaneous cooperation and competition are important for Aviation Valley and its members what is reflected in its statute indicating one of the basic rule and goal of the association – “to combine healthy competition with cooperation in particular areas” (AV's statute). The literature states that the significance of coopetition increases as products become more complex and as competition becomes global (Gnyawali and Park, 2009), and then it provides higher value in a shorter time than competitive orientation (Dagnino and Padula, 2002). Due to that coopetition seems to play an important role inside Aviation Valley being supply chain providing extremely complex and modular final products like aviation engines, planes, gliders and helicopters.

The character of provided products and the existence of common goals of particular partners do not result in the fact that members are connected only by cooperative relationships. There are still some fields of activity reserved for competition, and the relationships between partners are rather coopetitive than

cooperative only. It is interesting as the supply chain members pay great attention to the isolation mechanism, and opportunistic behaviors which may appear during cooperation. That is why they delimit and respect the line between competition and cooperation – “We have non-aggression pact with companies from the Valley, we are aware in which areas there are opportunities for fruitful cooperation and which fields of our activity should be protected against – even the closest – our partners” (interviewee M); “We know where and how cooperate, and where do not incommode or disturb each other” (interviewee R). In the light of the above Aviation Valley can be described as a network being a dynamic combination of collaborative and competitive relationships and the loci of coopetition phenomena (Gnyawali and Park, 2009).

In technology intensive and global competitive markets like aviation and aerospace adaptation of the coopetition strategy is often only one, possible way of survival and development. In case of considered supply chain SMEs’ perceive coopetition as a simple path to the innovativeness, technological improvements (Gnyawali and Park, 2009) and leveraging capacity – “If we cannot realize the order placed by foreign customer, we try to recommend some companies from the Valley, even our direct competitors” (interviewee N, medium organization); “Norbert Polska (one of the members of AV) has very similar machine park to us, it is our the biggest competitor, but we sometimes buy their products and services [...] when we cooperate we do not show them some of our products [...] we are afraid that they may steal them” (interviewee O, medium organization). Otherwise, from the largest members’ standpoint tight cooperation with competitors beyond joint R&D activities gives the possibility of building a well-developed and efficient supply chain. Integration of widely dispersed subcontractors and suppliers provides shorter lead-time, higher level of suppliers’ specialization and transport costs reduction (Niosi and Zhegu, 2005). All those coopetition benefits can be used for leveraging global competitiveness. Therefore the key network members introduce coopetition strategy to ensure efficient managing supply chain (Bakshi and Kleindorfer, 2009).

The highly globalized nature of aviation industry causes that aerospace networks have not only strong internal, domestic connections but also are rooted in a dense mosaic of international and global links (Dos Santos and Neto, 2009). In case of AV its members carry out especially direct, cooperative and competitive activity on the domestic market, maintaining interdependent relationships with national partners. However, the majority of the biggest players being subsidiaries of global corporations (approximately 25% of AV – Table 1) maintain dense network of well developed relationships on the global market at the same time.

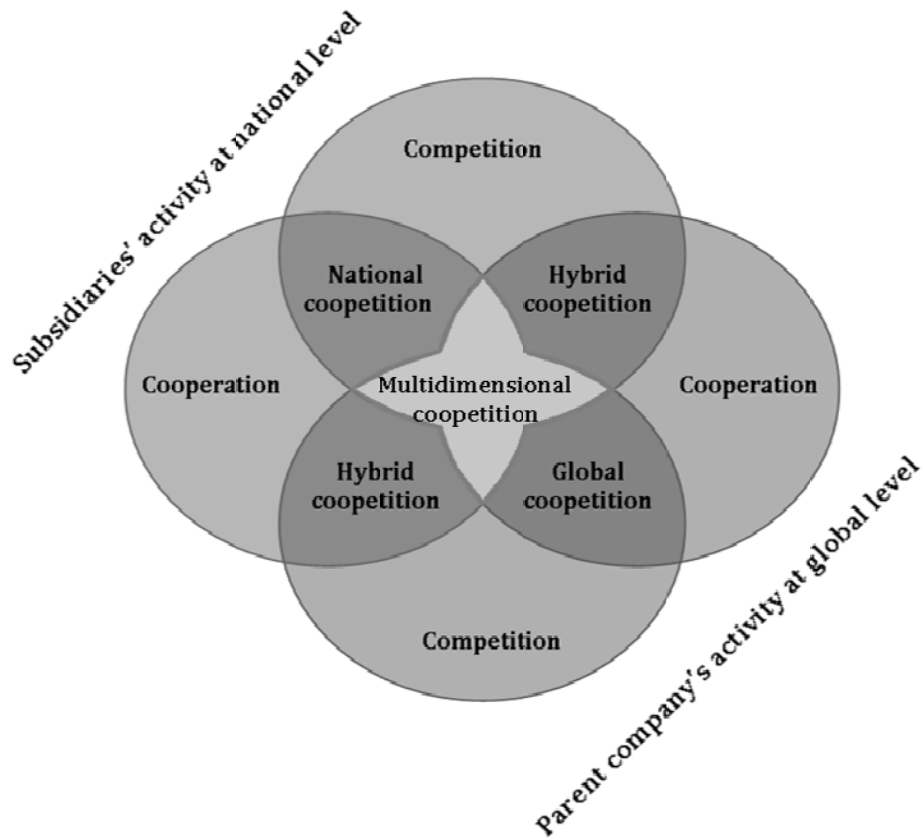
Table 1. AVA's members owned by global corporations

Polish subsidiary	Parent company	Headquarters
Avio Polska	Avio Group	Italy
CAV Aerospace	CAV Aerospace Limited	UK
Goodrich Krosno	Goodrich Corporation	USA
Kennametal Polska	Kennametal	USA
M&M Aerospace	B/E Aerospace	USA
PZL Mielec	Sikorsky Aircraft Corporation*	USA
PZL-Świdnik	Augusta Westland	UK/Italy
Hispano Suiza Polska	Safran Group	France
WSK Rzeszów	Pratt and Whitney*	USA
Zakład Kuźnia Matrycowa	Ladish Group	USA
Siemens Polska	Siemens	Germany
Vac Aero Kalisz	Vac Aero	Canada
Kreisler Polska	Kreisler Manufacturing Corporation	USA
King & Fowler Polska	King & Fowler	UK
MTU Aero Engines Polska	MTU Aero Engines	Germany
BorgWarner Turbo Systems Poland	BorgWarner Turbo Systems	USA
Sandvik Polska	Sandvik Group	Sweden
Hamilton Sundstrand Poland	Hamilton Sundstrand*	USA

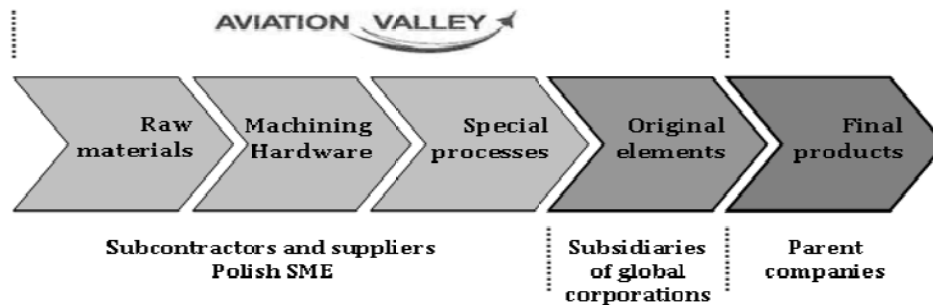
* Owned by United Technology Corporation (UTC), USA.

Those companies cooperate within cluster on industry development on both the national and global level. They build efficient supply chain consisting of SMEs by supporting shared production processes, stimulating procurement processes, facilitating warehousing, and conducting joint research. Simultaneously, they compete with other large and medium organizations in different fields of activity, namely production processes, innovation processes, sales and distribution. Furthermore, it is possible that at the same time their parent companies compete strongly at the global market of final products (e.g. engines, helicopters) or cooperate in the field of global R&D while the subsidiaries are connected through competitive, cooperative or coepetitive relationships on the domestic market. Therefore, there are processes of simultaneous cooperation and competition at the national level (subsidiaries operating within a Polish cluster) and coepetition taking place around the globe (parent companies operating at the global market – Dos Santos and Neto, 2009). The complexity and parallelism of coepetition trajectories (Bonel and Rocco, 2007) requires taking different levels of coepetition into consideration (Fig. 1). Such bi-level (national-global), holistic view indicates the multidimensional nature of coepetition.

Figure 1. Typology of coopetition in dependence of level of cooperation and competition



First, national coopetition – the simultaneity of cooperation and competition at the national level. The first aspect of national coopetition is related to the national cooperation which – to the authors' knowledge – is two-faceted. Firstly, it refers to the relationships between producers and subcontractors (77% of AVA members are small and medium suppliers and subcontractors – Fig. 2) which cooperate tightly as the final products are highly complex, extremely modular and technologically advanced – „It is important to develop and expand network of subcontractors along the supply chain, they should be located close to each other, in one particular region and be similar in terms of competences” (interviewee W).

Figure 2. Supply chain in aviation industry

On the other hand cluster's members collaborate in research projects. In general, the creation of aviation innovations, new technologies and knowledge takes place mainly through cooperation and co-competition under research projects supported by Polish government and European funds. Fast changing environment and shortening product life cycles call for collaboration (Amankwah-Amoah and Debrah, 2011) even with direct competitors. Indeed, more often the best partner is the greatest competitor (Chien and Peng, 2005) because it has appropriate and suitable knowledge potential as well as technological advancement – the need of bridging the resource gap stimulates cooperative initiatives. Moreover rapid and radical technological changes cause increase of R&D costs. Therefore more and more market members was looking for financial support being are more willing for collaboration on joint research projects (Niosi and Zhegu, 2005) enabling to achieve collectively a competitive advantage (Bonel and Rocco, 2007). Joint implementation of research projects allows the supply chain members to shorten the time of development of new technologies and to divide significant expenditure on innovations. Among the most significant benefits of joint implementation of research projects listed by aviation organizations there are: national and international business contacts, access to expertise and trainings, intangible resources of business partners, exchange of knowledge, technology and experience. The above-mentioned implications of collaborative processes are noticed mainly by SMEs while the biggest and the strongest cluster's members play the roles of innovation brokers. They support SMEs by helping them identifying their innovation and knowledge needs, setting up and managing the inter-organisational cooperation processes (Batterink et al., 2010). Indeed, they are network architects, operators and caretakers (Snow et al., 1992) being responsible for network management (Möller et al., 2005) and leveraging network performance. On the other hand the biggest organisations are aware that

only very cohesive supply chain can be the real vehicles of knowledge spillovers (Niosi and Zhegu, 2005) and innovation flows accelerators. It is also worth to add that to the great extent the development and the cohesion of the cooperation under the supply chain are mainly due to these large organizations and their overlapping objectives. Basically their highly complex and modular activity require a well operating vertical supply chain of diversified suppliers and sub-contractors as long as they have to face extremely high coopetition at the global market – “[...] We have to form and support well-functioning, vertical supply chain [...] to be able to provide final products” (interviewee W).

To sum up, the whole supply chain is developed through research projects, among the most important AV’s projects there are AERONET, CEKSO, Technological Foresight, Joint Sky, Research and Development Laboratory for Aviation Materials (Table 2).

Table 2. Collaboration through research projects

Projects	
AERONET	Centre of Advanced Technologies; development of aviation technologies and materials
CEKSO	Regional Centre for Transfer of Modern Technology; education of future workforce in Practical Training Centers for CNC operators
INTERREG IIIA	Development and promotion of cross-border Polish-Ukrainian aviation cluster
Technological foresight	Directions of development of material technologies
Joint Sky	Development and integration of the innovating aviation cluster; development of communication and knowledge exchange
Enterprise Europe Network	Knowledge and state of the art technology transfer
Wings for Regions	Development of cooperation between leading European aviation clusters
Aeropolis	Technology Park

In general, collaboration is strong side of Aviation Valley. It is not surprising since joint effort of different players in the value chain provide technological improvements and innovations (Cassiman, 2009). However, it should be noticed that the collaborative processes refers – only – to the one side of national coopetition within considered supply chain. Simultaneously, coopetition at the national level covers the competitive processes connecting particular members of the supply chain.

Aviation Valley concentrates almost the entire Polish aviation industry. Therefore it should not be surprising that within cluster there are some direct and indirect competitors. Generally the considered supply chain consists of independent, loosely coupled organizations differentiated in terms of size and ownership. They can also be divided according to the level of value chain at which they operate and according to the level of competition inside the network (Table 3).

Table 3. Example of competitors in the domestic market

Supply chain	Example members	Size	Competition level
raw materials	Alinox Arkomp HSW Narzędziownia Marco Expot-Import TW Metals	small and medium	local & national
hardware	BE Aerospace Technology Management Consultants-Poland		local & national
different types of machining	Admil Aviomechanika Creuzet Fin Iwamet Remog Ultratech		local & national
special processes	Cerel EL Automatyka King and Fowler Vac Aero		local & national
original elements	Avio Polska Goodrich Krosno Hispano Suiza MTU Aero Engines Pratt and Whitney Kalisz PZL Mielec PZL Świdnik WSK Rzeszów	large	national & global indirectly

Particular levels of value chain represent different areas of competition. The competitive relationships are differentiated. Most of AV's members are subcontractors and suppliers. Here the most intensive competition is reflected in the field of raw materials and treatment processes. Moreover most of subcontractors are Polish SMEs which compete on domestic market, within Polish part of global value chain. On the other hand AV's members owned by global corporations compete at the market of original elements (e.g. blades, turbines, engines) at both domestic and global level.

The essence of coopetition is that companies compete and cooperate parallelly in different fields of activity. The national coopetition arises from overlapping national cooperation and national competition (Table 4) and can be described as coopetition strategy on meso level (Dagnino and Padula, 2002).

Table 4. Review of coopetition areas at national level

Cooperation		Competition	
Margański & Mysłowski Rzeszów University of Technology	testing of composites	new composite technologies	Margański & Mysłowski PZL Świdnik
Avio Polska Rzeszów University of Technology	research on aircraft turbines	energy-saving turbines	Avio Polska WSK Rzeszów MTU Aero Engines Rzeszów University of Technology
WSK Rzeszów Rzeszów University of Technology	research on aero- space propulsion	drive boxes	Avio Polska WSK Rzeszów
Rzeszów University of Technology Warsaw University of Technology*	multifunction moto-glider	light and ultra-light gliders	Margański & Mysłowski Rzeszów University of Technology Warsaw University of Technology* PZL Mielec
Royal Star Fly WSK Rzeszów PZL Mielec	testing new products and service	pilot trainings	Rzeszów University of Technology Royal Star Fly
Aviomechanika Norbert Polska	thermal and electro-chemical treatment	machining	Aviomechanika Norbert Polska Arkcom Erkom

* Does not belong to the AV.

Considering coopetition strategy among the set of independent organizations the broaden view is needed. Particular member can compete in one area with one network member (A) and at the same time it may cooperate within that area with another (B). On the other hand that particular member can cooperate with some network members (A or/and B) in one area and at the same time compete with them within different fields of activity. Thus within the Aviation Valley the complex network coopetition (Dagnino and Padula, 2002) can be identified.

The existing literature states that coopetition is a combination (Bengtsson and Kock, 2000; Gnyawali and Park, 2009; Li et al., 2011) of appropriate level of competition and cooperation. Base on the intensity of those relationships Luo distinguishes four types of approach to coopetition (Osarenkhoe, 2010): alienator (monoplayer), contender, partner and co-opetitor (adapter). These types differ also in rent-seeking strategic behaviours (Lado, 1997). Within the Aviation Valley all of these coopetition models are introduced (Fig. 3.) as the network members apply differentiated configurations of competitive and cooperative relationships.

Figure 3. Example of different types of coopetition among AVA.

		Competitive orientation	
		Low	High
Cooperative orientation	High	Partner displaying collaborative rent-seeking behavior, e.g. Rzeszów University of Technology	Co-opetitor (Adapter) displaying syncretic rent-seeking behavior, e.g. WSK Rzeszów
	Low	Alienator (Monoplayer) displaying monopolistic rent-seeking behavior, e.g. Cerel	Contender displaying competitive rent-seeking behavior, e.g. PZL Świdnik

Source: Based on Luo's typology [Luo et al., 2006]

First, monoplayer (or alienator) maintains low degree of both cooperation and competition. For instance Cerel Energy Institute does not show strong engagement in cluster's activity. It remains on the periphery of the cluster – “It is good to have Valley's logo on our website, it adds prestige, but nothing more” said Cerel's director. Second, contender maintains high degree of competition and low degree of cooperation. Within Aviation Valley PZL Świdnik introduces a contender model. It competes e.g. with WSK Rzeszów at the nacelles market and with Norbert Polska at the engine cowling market. On the other hand it does not show strong commitment in cooperation within the cluster – „We are a little bit on the edge of the Valley [...] we do not have the material advantages, in case of projects we prefer cooperate internationally” (R&D manager, PZL Świdnik). Third is partner that exhibits strong willingness to cooperate and aversion to compete and in case of AV the Rzeszów University of Technology (RUT) displays this approach. It participates in most of the projects conducted within AV, very often even as a coordinator or initiator – „We need urgently good regional aviation, which is why we have to cooperate” (RUT professor). On the other hand it is public university, so it does not engage in economic activity in the aviation sector. Therefore RUT does not display competitive behaviors. Last, but not least is the co-opetitor which maintains high degree of cooperation and competition. In case of Aviation Valley the WSK Rzeszów could be an example of the adaptation of this type of coopetition strategy. It is strongly engaged in the most of cooperative projects and initiatives and at the same time it doggedly competes with Avio Polska (turbines, blades) or PZL Świdnik (engines) at the national level. As you can notice all of the considered above coopetition models are differentiated in terms of coopetitive relationships (Bengtsson and Kock, 2000). A cooperation-dominated relationship appears when coopetitive relationships consist of more cooperation than competition

(typical for partner's approach). A competition-dominated relationship occurs when cooperative relationship includes more competition than cooperation (standard for contenders). Finally, an equal relationship appears when cooperation and competition are equally distributed (characteristic for alienators and co-opetitors).

Second, global coopetition – the simultaneity of cooperation and competition at the international level. While Polish branches and subsidiaries cooperate, cooperate or compete among Aviation Valley's boundaries restricted to the borders of Poland (national level), their global owners cooperate, compete, cooperate internationally (global level) –Figure 1.

The global corporations represented in AV belong to the world's leading aerospace and aviation companies. They are main suppliers and subcontractors for such companies like Boeing, Airbus, Bombardier, Embraer, or Lockheed Martin. At the global level they also have to deal with global competitors like Turbomeca, Snecma, Rolls-Royce, Renault, GE Aviation, Tusa Engine Industries, or Volvo Aero. The nature of the global aerospace industry motivate to (or even impose) international collaboration, but at the same time high global competition cannot be removed. Therefore global aviation companies just as their subsidiaries at national level, implement coopetition strategies at the global one. It means that they maintain both, competitive and cooperative relationships with members of global aviation industry (Table 5). For example MTU Aero Engines and Avio Group cooperate with global leaders on new, high-efficient liquid fuel while United Technology Corporation conducts research in the same area on its own. At the same time UTC together with Avio Group is working on new low-pressure turbine and together with MTU Aero Engines on blades improvements.

Table 5. Review of cooperative and competitive fields of activity between aviation world leaders

Global corporations		Cooperation	Competition
1	2	3	4
United Technology Corporation (Hamilton Sundstrand Power Systems; Sikorsky)	Augusta Westland	Electric power, engine control systems, gearboxes	Helicopters
United Technology Corporation (Pratt and Whitney Canada)	Safran	Shafts for aircraft engines	Engine components – gears, housings
United Technology Corporation (Pratt and Whitney Canada)	Avio Group	Low pressure turbines and the power transmission	Turbofan power plant systems, blades and turbines
United Technology Corporation (Pratt and Whitney Canada, Sikorsky)	MTU Aero Engines	Engine components – blades and turbines	Liquid fuels

table 5 cont.

1	2	3	4
MTU Aero Engines	Avio Group	Atomization and combustion of liquid fuels	Engine components – blades and turbine components
Avio Group	Augusta Westland	Joint Technology Initiative (JTI) – clean sky	In the helicopter sector, Avio cooperate with GE Aviation and UTC – main competitors of Augusta Westland

Considering the nature of global cooperation, the configuration of cooperative and competitive relationships fully reflects the characteristic of national competition (cf. Tables 4 and 5). Global corporations are more willing to cooperate in the first stages of global value chain and are more focused on competition in the final ones (Bengtsson and Kock, 2000). However, there is significant difference between national and global competition. In case of global competition strategy there are no restrictions on the selection of partner for collaboration. For example Avio Group and MTU Aero Engines cooperate with the main competitors of UTC which remain outside the main and basic supply chain providing e.g. aviation engines. But at the national level, within Aviation Valley it is forbidden to maintain collaborative relationships with the most dangerous competitors not belonging to the cluster and remaining outside the supply chain – “Cooperation with GE or Rolls-Royce is frowned upon. You know they are the great trinity: GE, UTC and Rolls-Royce. If you provide something for UTC you can forget about the other two and vice versa. We are in Rolls-Royce and GE’s databases but it is better to not cooperate with them” (vice president of medium enterprise). The difference between national and global competition inside aviation industry results from the nature of relationships between companies. Global corporations are completely autonomous. In turn, AV’s members form a cohesive cluster together and they have to adhere to the generally applicable principles of cooperation imposed by the whole strategic network. They have to comply even if they remain formally and officially independent. For instance, Zakład Kuźnia Matrycowa supplies rugged, reliable, high-quality forgings for the most important AV’s players (e.g. Avio Polska, Goodrich Krosno, Hamilton Sunstrand Polska, WSK Rzeszów, MTU Aero Engines Polska and PZL Mielec) and it does not provide (and according to the statute of AV it is not allowed to provide) any services for aviation companies remaining outside the cluster. At the same time its parent company (Ladish Corp.) is a subcontractor for GE Avia-

tion, Rolls-Royce, Tusas Engine Industries and Volvo Aero – the greatest competitors of UTC, MTU Aero Engines and Avio.

Third, hybrid cooperation – the simultaneity of national (global) cooperation and global (national) competition at the international level. Hybrid cooperation occurs when: a) subsidiaries at national level cooperate with each other, while their parent companies compete at global level, or b) subsidiaries compete at national level, while their parent companies cooperate with each other at global level one. One of the common forms of hybrid cooperation in aviation industry is competition in the sphere of R&D. At the national level AV's members cooperate through participation in wide range of research projects that aims at gaining financial support, inventing new components or developments of provided engines. At the same time their parent companies compete globally at the sphere of R&D activity trying to win the race for new technologies and improvements of the final products like aircraft and aerospace engines. For instance, MTU Aero Engines and Avio Group cooperate separately with Turbomeca, Snecma, Rolls-Royce and Renault together on new, high-efficient liquid fuel. In other words, at the global market they realize separate, competitive research projects which aims are covering. At the same time, the MTU Aero Engines and Avio's subsidiaries cooperate at the Polish market for instance within AERONET on composite technologies.

Fourth, multidimensional cooperation – the simultaneity of national cooperation and global cooperation. The most complex dimension of cooperation refers to the situation when companies adopt cooperation strategies at both global and national level. Within Aviation Valley the multidimensional cooperation occurs when both subsidiary and its parent company adopt cooperation strategy. Therefore multidimensional cooperation affects only the largest and the most important members with international roots. From the perspective of particular members of Polish supply chain multidimensional cooperation refer to the situation when they cooperate directly at national level and simultaneously cooperate indirectly (through their parents companies) at the global one. For instance Avio Polska (owned by Avio Group) is connected with PZL Świdnik (owned by Augusta Westland) by cooperative relationships as they cooperate in the area of production of the composites and compete in the field of energy-saving turbines. At the same time Avio Group (owner of Avio Polska) is connected with Augusta Westland (owner of PZL Świdnik) by cooperative relationships as they cooperate under the Joint Technology Initiative of and compete on the market of helicopters. In such situation Polish subsidiaries cooperate directly at the national level and cooperate indirectly at the global level what is characteristic for multidimensional cooperation.

Conclusions

Coopetition can be identified when cooperative and competitive relationships are identified at the same time, and competition and cooperation between independent organizations are implemented in parallel. In case of considered network, being complex supply chain and an integral part of global aviation/aerospace value chain, coopetition seems to be multifaceted phenomena. It can be identified between varied stages of supply chain and observed at different levels of aviation activity. In authors' opinion it is possible to distinguish four types of coopetition inside supply chain, namely: national coopetition, global coopetition, hybrid coopetition and multidimensional ones. All of the above-mentioned types of coopetition are varied in terms of: a) the market scope of coopetition, b) types organizations engaged (i.e. subsidiaries/parent organizations), c) stages of supply chain maintaining cooperative relationships, and d) complexity and directedness of coopetition.

First, the simplest variant of coopetition is the **national coopetition** referring to simultaneous cooperation and competition at the national level and reflecting joint occurrence of cooperation and competition across functional areas within cooperating members of supply chain (Luo et al., 2006). Inside Aviation Valley national coopetition takes place at the early stages of the overall global value chain (Figure 2). This level of coopetition applies to all cluster members implementing cooperative strategy: all members of supply chain cooperate in the field of R&D, but the SMEs cooperate also in the area of aviation components and special processes provided for the largest organizations (subsidiaries of global corporations).

Second, the geographically distant **global coopetition** referring to simultaneous cooperation and competition at the global level. In case of Aviation Valley global coopetition takes place at the final stages of the overall global value chain (Figure 2) and is related to large organizations being subsidiaries of global corporations. These supply chain members owned by international corporations are indirectly related to each other by cooperative and competitive relationships at the global level as they parent companies maintain cooperative and competitive relationships with each other at the global market, at the stage of final products. In other words, in global coopetition it is possible to identify indirect cooperative relationships between subsidiaries as they owners adopt cooperative strategy at the global level.

Third, **hybrid coopetition** referring to simultaneous cooperation and competition at the global and national level at the same time (a combination of national competition/cooperation and global cooperation/competition). Inside Aviation Valley hybrid coopetition takes place at the all of the stages of the overall

global value chain (Fig. 2). For instance, a parent company competes for final product market at the global level (cooperates on research and development of new products at the global level) while its subsidiary cooperates on joint implementation of the research project at national level (competes on sales of aviation components at national level). It should be added that that type of coopetition occurs rather temporarily and is related mainly to the largest and the most important members of AV having global owners.

Last, but not least dimension of coopetition within supply chain is a **multi-dimensional coopetition** referring to simultaneous cooperation and competition at the global and national level at the same time. As opposed to the hybrid coopetition it appears when both subsidiary and its parent company implement coopetition strategies and coopetition takes place simultaneously on two levels: global and national. It means that both the subsidiary and parent organization maintain coopective relationships. It is the most advanced and complex coopective interdependences related especially to the most important players within national supply chain and global value chain. In case of Aviation Valley multidimensional coopetition takes place across all of the stages of the overall global value chain (Fig. 2).

To summarize, the plurality of coopetition levels and dimensions makes Aviation Valley intensive coopetition network (Chi et al., 2008) organized as a formal cluster consisting of independent however interdependent supply chain members. It is copious in both competitive and cooperative relationships. There are many competitors connected by coopective relationships at several levels of supply chain (Table 4 and 5). Within the domestic part of the global supply chain the cooperative relationships appear mainly at the early stages, especially in the R&D activity whilst the competitive ones occur especially at the final stages, in the field of finished aircrafts and its finished components. The obtained results remain in line with prior research on coopetition pointing out that the closer to the customer or final product, the stronger the competition between business network partners (Bengtsson and Kock, 2000).

It should be highlighted that network members are varied by the complexity and dimensionality of introduced coopetition strategy. The less complex and more one-dimensional coopetition refers rather to SMEs than to large organizations. On the other hand the most advanced and sophisticated variants of coopetition, i.e. multidimensional and hybrid coopetition are related to the most significant companies with strong international connections and global roots. The differences in the intensity and specificity of coopetition among and between particular members of supply chain are important as the nature of compe-

tion between cooptitors affects the level of cooperation they provide to each other (Gurnani et al., 2007). Therefore it can be said that these differences are reflected in the intensity and complexity of relationships, in the possible and achievable benefits of cooperation, and in the level of competitive advantage reached due to more or less intensive cooptition (Gurnani et al., 2007). Moreover there are both intentional and emerging cooptition (Czakon, 2009). Intentional cooptition refers rather to the largest and the most important network actors, while emerging cooptition refers to the SMEs. It points out the differences in the approach to the cooptition strategy adopted. The largest organizations seem to adopt intentional, purposefully benefit-oriented cooptition strategies while the SME supply chain members rather prefer the emerging approach appreciating and utilizing the benefits of cooptition strategy during its implementation.

In conclusion it should be said that the authors are aware of some limitations related to the presented considerations. The majority of them results from the methodological approach adopted. The research was based on a single, interpretative case study (Stake, 2009) aimed at theory building what we see as a barrier to generalization. Furthermore, all of the above-mentioned considerations refer to the cooptition phenomena observed in one, purposefully chosen supply chain functioning under specific, high-tech, networked and globalised environment. It means that the process of drawing general conclusions and statements ought to be careful, prudent and rather limited. However, the nature of the study was rather exploratory than explanatory what justifies the conclusions drawn based on one intentionally chosen case. To the authors' knowledge and besides all of the above-mentioned limitations the conducted research sheds some new light on the cooptition concept – especially in the field of the characteristic and specificity of cooptitive ties between and among cooperating cooptitors. The studies have proved the complexity and multidimensionality of cooptitive relations and have pointed out that the particular connections between cooptitors can be not only cooperative and competitive at the same time, but also that they can be varied in terms of level and scope of cooptition including national, global and multidimensional cooptition. Moreover the research has revealed some differences between large and SMEs in terms of the level of cooptition adopted. In authors' opinion that last aspect should be explored deeper in future research as the differences between large companies and SMEs in their strategic approaches, performances and scope of activity may be connected with the level of the maintained cooptitive relationships within supply chain.

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