Coopetition in high-technology firms: resource-based determinants

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Abstract: Coopetition arises out of two significant forces: the pressure of competition and the desire for cooperation. It denotes joint activity undertaken by entities which at the same time remain in competitive relationships. For high-technology firms, coopetitive relations are conditioned by pressure for innovation, the complexity and high level of technological advancement of products, and the heterogeneity and uniqueness of resources. Based on a survey of 230 high-tech firms operating in Poland and in international markets, it was found that the level of resources held and the deliberate creation of an excess of them (redundancy) are strong determinants of the formation of coopetitive relationships by those firms. The more resources a firm has, the more willing it is to simultaneously cooperate and compete with its rivals, and those resources have a stronger influence on the intensity of competitive activity than on that of cooperative activity within coopetition.

Key words: coopetition, competition, cooperation, resource-based theory, redundancy, high-technology

1 Introduction

The dynamic development of the resource-based approach to management has highlighted the importance of a firm's non-material resources [23, 12] and dynamic capabilities [35, 14, 1]. This in turn has drawn researchers' attention to relations between organizations being business partners [31, 8] and systems of such relations, a manifestation of which is interorganizational networks [18, 39]. One of the approaches to explaining network strategy is in terms of parallelism of competition and cooperation, which Wit and Meyer describe as a paradox: rivalry versus cooperation [13]. Cooperation means seeking synergy in interorganizational relations, and involves a process of creating added value in a network, while competition relates to the dividing up of that value [6]. Apart from relations with customers and suppliers, firms are more and more frequently establishing cooperative relations with competitors; this is called *coopetition* [5]. This is particularly visible in the high-technology sector [30, 17]. Firms in this sector are innovative, technologically advanced, and knowledge-based [41]. Pressure for innovation and the creation of new knowledge, particularly technological, compels such firms to incur high expenditure on research and development (R&D) activity,[1] while the high costs of R&D work, investment risk and the ever shorter life cycle of high-tech products provide strong reasons to undertake cooperation in the creation of new technologies, not only with research and development centres or technology transfer entities, but also with competitors. Coopetition is also encouraged by the complexity and high level of technological advancement of products and by the heterogeneity and uniqueness of resources, which could not be created independently within the time frame imposed by the dynamics of the market [4]. The specific and complementary nature of the resources engaged in coopetitive relations are a source of relational competitive advantage [16], which results from the joint use of specific resources by a firm and its coopetitor, and whose driving force is the "relational rents" [22].

Coopetition is thus driven by resource-related factors, which arise from the resource-based theory of the firm [2, 10]. It should be noted, however, that the theoretical basis for coopetitive relationship is also rooted in game theory [5, 25], the theory of transaction costs [38, 15], the theory of social capital [20], and interorganizational dynamics [36].

The purpose of this paper is to investigate the establishment of coopetitive relations by high-tech firms in terms of resource-based factors. The study is based on a survey conducted among 230

[1] R&D expenditure of more than 8% of revenue is a quantitative variable used to distinguish high-tech firms from those in the medium-high-technology, medium-low-technology and low-technology categories [7].

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companies based in Poland that operate either in Poland or in the global marketplace.

The paper is structured in accordance with its aim. First the phenomenon of coopetition is described with reference to resource-based theory. Secondly the methodology and scope of the survey are presented. Thirdly the results obtained are presented and discussed. The paper ends with conclusions and suggestions for future research.

2 Coopetition in resource-based theory

Resource-based theory (RBT) describes a firm as a unique set of material and non-material resources and capabilities which distinguish it from competing entities and are a source of competitive advantage [26, 37, 3]. The basic assumption of the theory is that valuable, rare, inimitable resources and organization resources lead to competitive advantage (the VIRO model of Barney [2]). In creating such advantage firms adopt four basic assumptions: (1) the variety of resources being at the firm's disposal; (2) limitation of competition ex post; (3) the imperfect mobility of resources; and (4) limitation of competition ex ante [27]. Key elements in resource-based theory are therefore the acquisition and accumulation of resources and the ability to use resources to obtain other resources, to perform original transformation of resources into goods and services, to market those goods and services, and generally to take advantage of opportunities [21]. These issues are addressed in several currents and concepts arising out of the resource-based view (RBV), which today constitute an intrinsic part of RBT. They include in particular the concepts of core competencies [28], distinctive capabilities [34], dynamic capabilities [35, 1], knowledge-based theory of the firm (KBV) [24], organizational learning (OL) [33], technology-based new firms (TBNFs) [40], and others.

Resource-based theory also provides an explanation for the phenomenon of coopetition. Coopetition denotes simultaneous cooperation and competition between firms [5], which while remaining organizationally separate, compete and cooperate in a repeatable manner [42]. Cooperation means that firms can integrate their activities so as to achieve planned mutual benefits, while at the same time acting as rivals in order to pursue their own individual strategic goals. Coopetition is thus also understood as a system of actors operating on the basis of a partial concordance of interests and goals [9].

Coopetition makes it possible simultaneously to derive the benefits resulting from cooperation and the sharing of resources or creation of common resources, and to maintain competitive relations between the parties and for them to protect their exclusive, often unique, resources.

Competitors can form coopetitive relations with similar resource configurations, thus achieving advantages of scale, but a more common motivation is the complementary nature of their resources and the possibility of gaining access to resources which are hard to obtain individually. Coopetition provides an opportunity for mutual learning and for the acquisition of new capabilities and modern techniques and technologies. It is therefore of great importance in the development of innovative, knowledge-based, dynamic and complex firms [29]. An example of such firms is provided by the high-tech sector. Another important factor here is redundancy of resources, which makes it possible to take advantage of transient opportunities [21]. Creation of an excess of resources favours the undertaking of cooperation with business partners, including with competitors.

Coopetitive relations are also formed in order to limit particular resources for other competitors, which increases the competitive advantage of the coopetitors with respect to their remaining competitors [11].

On the other hand the specific nature of coopetitive relations, particularly their competitive character, causes a risk of resource leakage. Therefore coopetitors ought both to protect their shared resources against undesired leakage and use by competitors from outside the relationship, and to protect their own key resources which are not the subject of competitive cooperation.

Resource-based theory therefore emphasizes the importance of resource interdependency. On one hand it explains the reasons for cooperation, and on the other it shows why firms compete with each other and for what. Of fundamental importance for the formation of coopetitive relations is the variety of the resources held, their redundancy and restricted mobility.

The following hypothesis is proposed in relation to resource-based factors in coopetition: *The level of possession and redundancy of resources condition the formation of coopetitive relations by high-tech firms*.

In order to verify this hypothesis, a survey was carried out among a sample of 230 high-tech firms, selected so as to reflect the structure of that sector in Poland. The following sections describe the methods of data collection and basic findings.

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3 Research methodology

The survey of a sample of 230 high-tech firms was carried out in 2012. A criterion for selection was membership of the high-tech sector, defined in accordance with the Polish PKD business classification system.[2] The sample was selected on a quota basis[3] such that it corresponded to the structure of the high-tech sector in Poland and so that the results could be extrapolated to the whole population (a representative sample). The survey was conducted using a questionnaire by the PAPI (Pen and Paper Interview) method, namely personal interviews conducted by a researcher.[4] The research tool was a structured and standardized paper questionnaire. The respondents were owners and chief executive officers (CEOs) of firms, these being the people who take firms' strategic decisions, including decisions to undertake cooperation with competitors and determining the scope and nature of that cooperation.

The dominant group of firms among those studied were small firms (74.3%), followed by medium-sized firms (20.0%), with large firms accounting for the smallest proportion (5.7%). This reflects the size breakdown of firms in Poland as a whole. The surveyed firms represented all branches of the high-tech sector, with 102 firms engaged in industrial processing, and 128 providing high-tech services. There was a large degree of variation in the index of research and development expenditure: for most of the surveyed firms (171) the ratio of R&D expenditure to revenue was less than 5%, while for 32 it was over 8%, and for 27 it was between 5% and 8%. A large majority of the firms (76.5%) operate in the domestic market, while the other 23.5% operate in international and global markets.

3 Results and discussion

Coopetitive relationships were reported by 71% of the surveyed firms, which supports the view that high-tech firms, because of their specific characteristics, frequently undertake cooperation with their competitors. A total of 67 firms reported that they did not have such relationships, chiefly small firms with domestic operations only and low R&D expenditure. As regards the areas of coopetition in which relationships of that type have existed in the past or at present, respondents indicated primarily the areas of product manufacture or service provision (49.7%), sales and distribution (37.4%), purchasing (35%), creation of joint computer systems (28.8%), and R&D (27.6%). It should be noted that 19 firms reported cooperation with competitors in all of these areas. Among the firms which did not engage in coopetition, three firms expressed a desire to form such relationships in the future, and these related to the production/services area.

Among the motivations which persuaded the surveyed firms to enter into coopetitive relationships, the most important were:[5] obtaining market access (the average score for the importance of this motivation for coopetition was 4.02), strengthening of position with respect to competitors not involved in cooperation (3.89), expansion of scale of operations (3.89), increased innovativeness (3.81), reduction of costs, particularly transaction costs (3.76), and acquisition of resources, particularly technical and technological knowledge (3.74).

Respondents also assessed the level of possession of particular resources in the firm (Table 1).

Analysis of the results given in Table 1 shows that the level of resources in firms where coopetition occurs is higher than in those which lack coopetitive relationships. This implies that the higher the level of possession of particular resources (their redundancy), the more often and more willingly firms establish coopetitive relationships. An

[2] The Polish business classification system PKD *(Polska Klasyfikacja Działalności)* corresponds to the European statistical business classification NACE Rev. 2, introduced by Regulation (EC) No. 1893/2006 of the European Parliament and Council. According to NACE Rev. 2 (sectoral approach), high-tech industries include manufacturers of basic pharmaceutical products and pharmaceutical preparations, manufacturers of computers, electronic and optical products, and manufacturers of air, spacecraft and related machinery, while high-tech knowledge-intensive services include telecommunications, computer programming, consultancy and related activities, information service activities, and scientific R&D (high-technology and knowledge-based services aggregations based on NACE Rev.2, 2012) [19].

[3] Quotas were selected based on the high-tech sector according to NACE Rev. 2 and size of firm: small (1–49 employees), medium (50–249 employees) and large (over 249 employees). The structure of the high-tech sector was determined based on data from the Polish Central Statistical Office (GUS), and the survey operator was the business database *Polskie firmy* and *Panorama firm*.

[4] The carrying out of the survey was outsourced to one of the largest research firms in Poland with qualified interviewers, TNS Poland.

[5] Respondents were given a list of motivations for entering into coopetition and asked to assess their importance on a scale of 1 to 5, where 1 meant that the motivation had very little importance, and 5 that it was very important for the undertaking of coopetition.

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exception is market resources (namely brand, reputation, distribution channels, loyal customers, etc.). Firms not engaging in coopetition assessed their level of these resources higher (average 3.85) than firms which are coopetitors (3.68). This may result from a conviction that a relatively high level of market resources will ensure a firm's competitive advantage, meaning that it has no need to engage in coopetition.

Table 1. Evaluation of firm's resources from the point of view of establishing coopetitive relations[6]

Type of resources	Firms with coopetitive relations N=163			Firms without coopetitive relations N=67		
	$\bar{x}$	M	Q	$\bar{x}$	M	IQR
material resources	3.11	3	1	3.06	3	1
financial resources	2.97	3	2	2.87	3	0
market resources	3.68	4	1	3.85	4	2
number and structure of staff	3.02	3	2	2.78	3	2
skills and talents of employees	3.67	4	1	3.48	4	1
organizational resources	3.09	3	1	2.84	3	3
information resources:						
- information systems	3.60	4	1	3.10	3	2
- patents, licences	2.98	3	2	2.34	3	2
relations with						
- high-tech and R&D units	3.06	3	2	2.70	3	3
- other relations	3.56	4	1	3.19	3	1

$\bar{x}$ = mean M = median IQR = interquartile range
Source: own research

Firms cooperating with competitors have the highest levels in the categories of market resources, personalized knowledge (skills and talents of employees), information resources (in terms of possession of suitable IT systems), and relational resources (in terms of ability to form relations with institutions in the business environment, such as customers, suppliers and local authorities). This is demonstrated by the median score of 4, which means that 50% of respondents rate their level of these resources as high or very high. The low values for interquartile range (IQR=1) confirm that respondents' scores are not much differentiated.

To verify whether there exist statistically significant differences ($p<0.05$) in assessments of the level of possession of particular resources depending on the area of coopetition, a Kruskal–Wallis test was performed. The results indicated that coopetition in the area of R&D (joint creation of new technologies) was engaged in primarily by those firms which evaluated highly their relations with other high-tech firms and research centres, and by those which had a sufficient number of staff with an appropriate structure. On the other hand, the lower the level of firms' material resources (machinery, equipment, R&D base, etc.) and organizational resources (internal processes, management systems, structure), the more often and willingly they established coopetitive relationships in the area of human resources (joint training, staff leasing, etc.).

Next, respondents assessed the effect of resources held and their redundancy on the intensity of competitive and cooperative activity within coopetition. The results are given in Table 2.

Table 2. Effect of resources on coopetition

Effect	Effect on intensity of competitive activity N=163				Effect on intensity of cooperative activity with competitors N=163			
	resources held		redundancy of resources		resources held		redundancy of resources	
	N	%	N	%	N	%	N	%
strongly suppressive	4	2	5	3	3	2	3	2
weakly suppressive	11	7	21	13	8	5	14	9
no effect	43	26	85	52	64	39	92	56
weakly favourable	32	20	19	12	54	33	43	26
strongly favourable	73	45	33	20	34	21	11	7

Source: own research

The level of resources has a greater effect on the intensity of competitive activity than on that of cooperative activity within coopetition. In relation to competitive activity, 65% of respondents assessed the effect of resources possessed as favourable, including 45% answering strongly favourable. As regards cooperative activity, 54% of respondents indicated that the resources held are favourable to cooperation with rivals, including 33% stating this effect to be weak, and 21% strong. It should be noted that the higher the level of possession of various resources (particularly material, organizational and information resources), the stronger is their effect on the intensity of cooperative activity with competitors (Table 3). Similarly, the higher the level of particular resources (except for resources relating to information systems), the greater is the effect of redundancy of resources on the intensity of cooperation with rivals.

[6] Respondents were given a list of resources and asked to assess their level of possession of those resources on a scale of 1 to 5, where 1 meant a very low level, and 5 a very high level (resource redundancy).

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Table 3. Spearman's correlations between evaluation of level of resources held and their effect on the intensity of competitive and cooperative activity within coopetition

	Effect on coopetition[7]			
Resources[8]	A	B	C	D
1	**0.25**	**0.25**	**0.34**	**0.37**
2	0.10	0.11	0.08	**0.16**
3	**0.22**	**0.20**	**0.22**	**0.24**
4	0.10	0.09	**0.20**	**0.26**
5	0.02	**0.20**	**0.18**	**0.28**
6	**0.15**	**0.18**	**0.24**	**0.27**
7	0.03	**0.23**	**0.25**	0.12
8	-0.01	**0.32**	**0.18**	**0.23**
9	-0.06	0.06	0.13	**0.24**
10	0.10	**0.16**	**0.22**	**0.24**

Note: $R \geq 0.15$ is essential with min. $p<0.05$

Source: own research

Only in a few firms do the level and redundancy of resources have a suppressive effect on both competitive and cooperative activity; here cooperative activity is suppressed primarily by moderate and low resource levels. Most respondents (73%) believe that coopetitive relations have accelerated the development of their firms.

The results presented here seem to confirm the proposed hypothesis. Resources held and the deliberate creation of an excess of them (redundancy) are a strong determinant of the creation of coopetitive relations by high-tech firms. The more resources a firm has, the more willingly it will simultaneously cooperate and compete with its rivals. On one hand an excess of resources enables a firm to share them with competitors in areas subject to cooperation, and on the other hand it makes it possible to compete in areas not subject to cooperation. Moreover coopetition makes it possible to acquire resources of which the firm has an inadequate amount, and also to create new shared resources, which was one of the main motivations for entering into coopetition.

4 Conclusion

Research into coopetition has been developing significantly in recent years. Simultaneous cooperation and competition between firms has its basis in resources. Competitors can enter into coopetitive relationships in order to acquire complementary resources (transaction logic), or having similar resource configurations in order to obtain advantages of scale and strengthen their advantage over other competitors (competitive logic) [32].

Level of resources and their redundancy are factors that condition engagement in coopetition by high-tech firms, and the relations established are based chiefly on competitive logic. Deeper analysis of the resources of high-tech firms in the context of the establishment of coopetitive relations and their dynamics, forms, motivations, benefits and threats in particular areas of the value chain may prove an interesting direction to take in future research regarding coopetition.

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[7] (A) effect of resources held on intensity of competitive activity; (B) effect of redundancy of resources on intensity of competitive activity; (C) effect of resources held on intensity of cooperative activity with competitors; (D) effect of redundancy of resources on intensity of cooperative activity with competitors.

[8] Level of resources held: (1) material resources; (2) financial resources; (3) market resources; (4) number and structure of staff; (5) skills and talents of employees; (6) organizational resources; (7) information systems; (8) patents, licences; (9) relations with high-tech and R&D units; (10) other relations.

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