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PhD THESIS ABSTRACT

RESEARCH ON ACHIEVING A COLLABORATIVE MODEL OF SCIENTIFIC RESEARCH IN DEFENSE INSTITUTIONS

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C O N T E N T S

Legend: T - Thesis; **A** - Abstract.

Note: The content of the abstract preserved the same notes for chapters, figures, tables and annexes as the ones used in the PhD thesis paper.

Key words: *Scientific research, collaboration, modeling, collaborative modeling, cluster, collaborative governance, risk management.*

ACRONYMS

“HC”AFA	”Henri Coandă” Air Force Academy
“MB”NA	“Mircea cel Bătrân” Naval Academy
“NB”LFA	“Nicolae Bălcescu” Land Forces Academy
CBRN	Chemical, Biological, Radioactive, Nuclear
CDSSS	Center for Defense Strategic and Security Study
CSREAF	Center for Scientific Research in the Euro Atlantic Field
CSRFDRM	Center for Scientific Research in the Field of Defense Resources Management
CSRFMTOA	Center for Scientific Research in the Field of Military Tactical and Operational Actions
CTESRICS	Center for Testing, Evaluation and Scientific Research for Information and Communication Systems
CWTESR	Center for Weapon Testing, Evaluation and Scientific Research
DA	Department for Armaments
EAHERDIF	Executive Agency for Higher Education, Research, Development and Innovation Funding
EDA	European Defense Agency
EONR	European Organization for Nuclear Research
FRAC	Flight Research and Attempts Center
IDB	International Databases
ISI	Information Science Institute
MMSRC	Medical-Military Scientific Research Center
MoD	Ministry of National Defense
MTA	Military Technical Academy
NASR	National Authority for Scientific Research
NCSR	Navy Center for Scientific Research
NDU	”Carol I” National Defense University
NIRD	National Institute for Research Development
NIS	National Institute of Statistics
NRSF	National Reference Strategic Framework
R & T	Research and Technology
RAMET	Research Agency for Military Equipment and Technology
R-D	Research Development
RDI	Research, Development, Innovation
RDSP	Research-Development Sectoral Plan of the Ministry of Defense
S & T	Science and Technology
SRCCBRNDE	Scientific Research Center for CBRN Defense and Ecology
STO	Science and Technology Agency (NATO)

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Foreword

The moment of the public presentation of a doctoral thesis can be a more or less distant dream, a desire or a need. For me, this moment represents the fulfillment of a dream generated by necessity: that of knowledge. It is the end of a difficult road during which I experienced the sense of accomplishment, of victory and that of despair caused by failure.

Today, on completion of this work, I want to thank everyone who supported and helped me to get here.

My sincere thanks to Mr. Prof. Eng. Claudiu Vasile Kifor, PhD, for the dedication, scientific rigor and direct support given throughout the doctoral studies and preparation of this thesis.

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I left last those who are my first supporters; thank you to my wife and son for always being there for me, for their patience, understanding and support throughout this period.

To all, sincere thanks!

1. INTRODUCTION

Albert Einstein used to say: "Most people would stop after finding the proverbial needle in a haystack. I'd keep looking to see if there are other needles "(Calaprice, 2012). So would the brilliant scientist describe curiosity, that human specific interactive feature, which is most often channeled towards basic needs.

From this perspective, scientific research is established as a key pillar of the growth of welfare, the primary goal of modern society.

The analysis and evaluation of scientific research, of its degree of development and adequacy is one of the components that ensure both the sustainability of research approaches and the incentive to increase the quality of research.

In a competitive environment where, under the pressure of accelerated globalization, the fight for survival and supremacy in the market has taken the most aggressive forms, the organizations and especially their management is facing a multitude of problems that need to be solved in time and under optimal conditions.

In these circumstances, in order to achieve the assumed objectives, the management of organizations is forced to give a series of answers to questions like: When? With what forces? Under what conditions?

In most cases, a problem has several solutions, so management is constantly put in a position to choose the most advantageous one for the organization.

The decision of the organization to participate in the establishment of a collaborative model specific to scientific research is the embodiment of the maturity of the management system of, reflected by voluntarily accepting the benefits but also the potential risks stemming from such a combination.

1.1. Research objectives and methodology

1.1.1. The general objective - is to develop a collaborative model of scientific research in institutions in the field of defense.

1.1.2. Specific objectives

The following specific objectives have been defined:

– critical analysis of the research and development system specific to defense, considered relevant in terms of performance and capabilities to support the development and implementation of a collaborative model specific to this field;

– identification of the key features of collaboration in scientific research;

– identification of the stage of the development of cluster formation initiatives at European and national level;

– identification of the appropriate modeling techniques for designing a collaborative model of research;

- developing a conceptual model specific to scientific research;
- developing a set of performance indicators associated with activities specific to the collaborative model;
- developing the documentation to support the governance and the risk management of the accomplished model;
- model validation.

1.1.3. Research methodology - methods, techniques and research tools used in this thesis were:

- bibliographic research and analysis;
- quantitative analysis of data;
- investigation.

1.2. Structure of the thesis.

The thesis is divided into 12 chapters, as follows:

Chapter 1 - provides the introduction into the research topic and presents the general and specific objectives of the research, as well as the methods and means to ensure the achievement of the objectives.

Chapter 2 - critically analyzes the current state of development of scientific research in the field of defense.

Chapter 3. - deals with the concept of collaboration in an original manner. The starting point is given by differentiating between cooperative collaboration.

Chapter 4 - summarizes clarifications on the concept of cluster, its features and dimensions.

Chapter 5. - analyzes and synthesizes the main techniques and tools of quality management.

Chapter 6. - after having defined terms and concepts and after the presentation of classifications, the origin of new products, product life cycle and established models used in developing products and processes are presented and different ways of representing the processes are highlighted.

Chapter 7 - analyzes and synthesizes key concepts and main techniques and types to approach modeling.

Chapter 8 - presents the results drawn from the survey which aimed to analyze the manner in which the initiative to form a specific cluster for defense is perceived.

Chapter 9 - includes the development of the collaborative model of scientific research institutions in the field of defense.

Chapter 10. - analyzes and summarizes the main elements underlying the governance of the model.

Chapter 11 - summarizes the methods of analysis and risk assessment of the elaborated collaborative model.

Chapter 12 – presents the conclusions of the thesis contains a summary of the personal contributions and potential courses of action.

2. ASPECTS REGARDING THE ACTIVITY OF RESEARCH, DEVELOPMENT AND INNOVATION

2.1. Overview and principles

At the European Council in Lisbon in March 2000 was analyzed the competitiveness of scientific research in the European Union and a strategy was developed, whose goal established that the European economy would become, by 2010, "the most competitive and dynamic economy in the world, based on knowledge, capable of sustainable economic growth with more jobs and better and more social cohesion" (EurActiv, 2008).

2.2. The taxonomy of the research, development and innovation activity

Research and development includes (OG 57/2002):

- fundamental research;
- applied research;
- technological development;
- innovation.

2.3. RDI entities in Romania; role, mission, structure and performance

In essence, the national structure of R-D, includes:

- NIRD sites;
- Institute / research centers of the Romanian Academy;
- Accredited public or private higher education institutions;
- Institutes / RD centers of public or private companies;
- Institutions / RD centers organized as public institutions;
- International Centre for R-D;
- Other institutions, public or private, that have as object RD.

Their share in the national RD system is shown in the following table:

Table 2.1. Share of R-D entities according to the area of coverage

Type	Number	%
Governmental performance sector	111	1,08%
High education performance sector	108	1,05%
Enterprise performance sector	9986	97,51%
Private non-profit performance sector	30	0,29%
Defense sector	6	0,06%

(adapted from www.anelis.ro; Statistic annuity 2011)

2.3.1. Role and missions of RDI in Romania

Governmental performance sector - comprises:

- NIRD sites coordinated by NASR;
- NIRD sites coordinated by ministries;
- Public institutions subordinated to NASR;
- Public institutions under the Romanian Academy.

Higher education performance sector - "Higher education is organized in universities, research academies, institutes, higher education schools and other such state, private or confessional institutions, " (Law no. 1/2011).

Business performance sector – the core of this sector consists of private companies, and for some of them RDI is the main activity.

Private non-profit performance sector – the RD activity of these entities can be a punctual or conjunctural objective thereof.

2.3.3. Performance CDI entities in Romania

The following table presents quantified data of the types of scientific products of the institutions of higher education in Romania, taking part in national exercise "classification and ranking of universities curricula":

Table 2.3. Total number of articles/types of articles according to universities (between 2006-2010)

Product type	ISI a	ISI b	ISI c	ISI d	BDI
Total	15.377,12	50.048,16	465,43	14.452,76	53.665,57

(source: http://uefiscdi.gov.ro/articole/2535/Clasificare-universitati-si-ierarhizare-programe-de-studii.html)

2.4. Scientific research in the field of defense

2.4.1. Scientific research in the field of defense specific to NATO and UE

All activities specific to research and technology developed at NATO level are circumscribed to the *NATO Defense Planning Process* (NDPP), the process by which NATO identifies capabilities and promotes their development and acquisition by allies, so that it can fulfill its security and defense objectives. The steps of this process are shown in Figure 2.13.

Figure 2.13. NATO Defense Planning Process
(adapted from http://www.nato.int/cps/en/natolive/topics_49202.htm)

The Agency for Science and Technology (STO) works at NATO level, from an institutional perspective.

At EU level, the *European Defense Agency* (EDA), subject to the European Union Council, is the institution that fulfills four main functions in the RD direction, namely:

- developing defense capabilities;
- armaments cooperation;
- industrial and technological base and European military defense equipment market;
- promoting cooperation for research and technology.

2.4.2. Romanian scientific research in the field of defense

The RD system of the MoD consists of:

a) military higher education institutions of the three categories of military forces, Land, Air and Navy;

b) military higher educational institutions subordinated to the minister and / or coordinated by certain departments;

c) Research Agency for Military Equipment and Technologies Bucharest, subordinating military research centers;

d) Medical - Military Scientific Research Centre – subordinated to the Medical Directorate of the MoD.

2.5. Funding scientific research activities

2.5.1. Domains of scientific research funded in Romania

In Romania, RDI is founded and funded based on programs, which explain the research areas.

2.5.2. Domains of scientific research funded through UE Framework Program 7

The Framework Program for Research and Technological Development 7 abbreviated FP7, represents the EU's main instrument for funding research in Europe, which ran between 2007 to 2013.

2.5.3. Modalities of funding scientific research:

- self-financing - specific, most often, to multinationals;
- medium and long term bank loans;
- leasing;
- factoring;
- budget financing through research programs and university grants. 2.5.2.

2.5.4. Modalities of funding R - D activities specific to the field of defense

Basically, the funding of RD is made from the state budget through two main channels, namely: the Ministry of National Education, through subordinated specialized institutions and the Ministry of Defense.

Military higher education institutions receive funding for the RD activities, based on competition, through PN II projects.

3. ASPECTS REGARDING THE COLLABORATION IN THE ACTIVITY OF RESEARCH-DEVELOPMENT

3.1. Introduction

Bibliometric studies are published evidence of research - most often documents and reports, patents and agreements are considered indicators of trends and processes. Co-author is commonly used as an indicator of cooperation.

3.2. Approaches to collaboration

Collaboration is considered to be a "common creative process that allows organizations to have other forms of organization, but involve the conduct of a joint, activity, developing concepts and innovative products" (Podean, 2011).

Collaboration is often confused with cooperation because many people fail to distinguish between the two terms and, therefore, we will specify the key terms of collaboration (Camarinha-Matos & Afsarmanesh, 2008):

1. **Communication –** the starting point in any process of collaboration representing the mutually beneficial exchange of information;

2. **Coordination** refers to people, activities and resources management;

3. **Cooperation** is a subset, since collaboration is a process that requires members to exchange information and to adapt their activities and to share resources to achieve consistent objectives.

3.3. Manifestation media of collaboration:

- Arts;
- Sports;
- Business;
- Education;
- Economics.

3.4. Dimensions of collaboration within the organization - key dimensions of collaboration depend on the organizational variables specific to each type of entity. These variables include: division of labor, scientific management system, the degree of formalization (including administrative contracts) and the hierarchical decision-making system.

3.5. Levels and forms of collaboration

The levels of both inter and intra collaboration are summarized in Table 3.1.

Table 3.1. Levels of inter and intra collaboration

	Intra-	Inter-
Individual	-	Between individuals
Research group/team	Between individuals belonging to the same research group	Between groups (from the same department)
Department	Between individuals or groups in the same department	Between departments (from the same institution)

Institution	Between individuals or departments in the same institution	Between institutions
Sectorial	Between	Between institutions in different sectors
National	Between institutions in the same country	Between institutions in different countries

(source Katz & Martin, 1997)

3.6. Types of collaboration

- **Bureaucratic collaboration** - is characterized by: hierarchical authority, the existence of written rules and regulations, formalized responsibilities and a specialized division of labor "(Weber, 1978).
- **Semi-guided collaboration** - is formally organized, has highly differentiated structures that serve the same purpose.
- **Non-specialized collaboration** - is complementary to semi-guided collaboration. Non-specialized collaboration displays less formalization and differentiation between the tasks of its members than bureaucratic or semi-guided collaboration.
- **Participatory collaboration** – the manner in which decisions are made has a strongly participative and consensual character, the organizational structure is established through verbal agreements or memoranda, and the levels of authority have only few internal decision-making structures.

3.7. Factors associated to collaboration in research

3.7.1. Motivation of collaboration in research

Specialized literature presents several reasons for collaboration in scientific research, including "access to expertise, access to tools, cross-disciplinary fertilization, improved access to funds, obtaining prestige and visibility, obtaining silent knowledge about technique, pooling knowledge to solve large and complex problems, increasing productivity, education, increasing specialization of science, entertainment and recreation" (Melin, 2000; Katz & Martin, 1997; Bozeman & Corley, 2004; Rafols & Meyer, 2007).

3.7.2. Dependent variables of collaboration in research

3.7.2.1. Collaboration in disciplinary and interdisciplinary research

Qin et al. (1997) define interdisciplinary research as "the integration of disciplines in a research environment."

Disciplinary collaboration is defined as "the collaboration between scientists of the same discipline in order to produce new knowledge" (van Rijnsoever & Hessels, 2011).

3.7.2.2. Academic positioning - a promotion in academic rank can be perceived by the researcher as a reward for his success in research.

3.7.3. Independent variables of collaboration in research - are used to predict dependent variables and, we consider relevant for our research efforts *the global innovative capacity* (as personality trait), *work experience, dynamic of the scientific domain, scientific disciplines and the gender gap*.

3.8. Researchers vs. Collaborators

The legislation of each state clearly mentions who has research fellowship and how to get professional ranks and functions in R & D activity.

4. CLUSTER-TYPE INITIATIVES

4.1. Introduction

Clusters are now the subject of a whole series of documents issued by national and international organizations (OECD, 2005, 2010, European Commission, 2008) and based on accumulated experience, the authorities promote the idea that "clusters increase competitiveness, specializes employment, and develop companies and regional economies "(Dan, 2012).

4.2. Collaborative Concepts: Industrial park. Scientific and Technological Park. Corporate networks. Cluster.

– **The industrial park** represents a delimited area in which take place activities in the economic, industrial production and services, of capitalizing on scientific research and / or technological development in specific facilities, to harness human and material potential of the area.

– **Scientific and technological parks** develop a privileged relationship between universities and innovative companies, constituting a starting point for technology transfer and the development of potential clusters.

– **Corporate networks** are a form of cooperation between legally independent firms, but with common economic interests, that are geographically dispersed.

– **Clusters** are "geographic concentrations of interconnected companies and institutions, which manifests in a particular field. Clusters include a group of related industries and other organizational entities important from the point of view of competition" (Porter, 1998).

4.3. Emergence and evolution of clusters

Studies have shown that this type of congestion may occur:

a) as exploitation of a strategic natural site;

b) as exploitation of reserves of resources, including specialized professional skills;

c) close to research institutes with an exceptional track record;

d) in areas with well-developed infrastructure;

e) in response to urgent local needs;

f) or as a result of the activities of one or more successful companies.

4.4. Specific characteristics of clusters

– **Dimension** - is a parameter that is influenced by numerous factors: age of the cluster, the type of market in which it operates, the aspiration of the entrepreneurship involved, the specificity of the business etc.

– **The geographical delimitation** - is still an extremely variable feature from one cluster to another. A cluster may include areas from different countries, as such agglomerations occur regardless of political borders between states.

– **Component companies and their relations** - some clusters can be dominated by small firms that subcontract mutual activities. In other cases, subcontracting systems may develop around one or more larger contractors.

– **Business relations outside the cluster** - depending on the degree of maturity, that some of the firms in the cluster may be dependent on external companies regarding the sourcing of raw materials, domestic marketing and the export of finished products.

– **Cluster competition –** the competitive activities of an economy are not evenly distributed within it. Usually, they are connected vertically (buyer / supplier relations) or horizontally (using the same technologies, channels, customers, community) and, not infrequently, these activities tend and focus on space, creating clusters.

– **Innovation and technology** - simultaneous collaborative and competitive relations that characterize the relations between companies of the same cluster contribute significantly to creating optimal conditions for innovation and to keeping alive the interest in self-improvement and renewal.

4.5. Composition of clusters

The main actors that contribute to the formation of clusters are shown in Figure 4.2.

However, experience has shown that, in Romania, the three natural partners of the model "Triple Helix" do not cooperate. Under these circumstances, it is necessary to adapt and transform it into a "Four clover" model (Figure 4.3) (Coşniţă 2007).

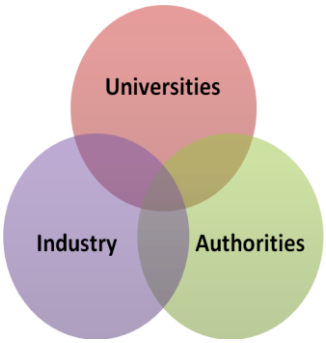

Figure 4.2. Triple Helix
(adapted from: Etzkowitz, 2002)

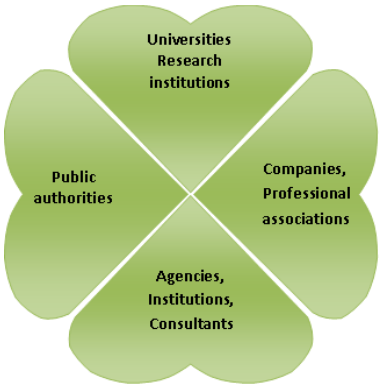

Figure 4.3. Four Clover Model
(adapted from Coşniţă, 2007)

4.6. Prerequisites for innovative clusters

The prerequisites for a successful innovative cluster are (Min. Ind, 2010):

– trust between members;
– voluntary participation;
– existence of a "critical mass"
– complementary activities and companies;
– interconnection through a common interest;
– demonstrated complementary existing skills;

- joint development strategy;
- ensuring independence for each member;
- dynamic and open cooperation;
- participants remain competitors in all respects;
- management is ensured by clearly defined structure;
- clear benefits for all members.

4.7. Benefits of clusters

The benefits of a company belonging to an innovative cluster are:

- increasing competitiveness and employment rate of labor by interconnecting people, skills, competencies and knowledge;
- increased efficiency because it is easier to work in a network with customers and suppliers;
- stimulating innovation, as customer interaction creates new ideas and greater pressure on innovation;
- reducing constraints for SMEs by large companies;
- increasing opportunities for internationalization of SMEs;
- chance of success for start-ups and spin-offs;
- the capacity to influence educational profiles in order to meet the requirements of the company in terms of qualified human resource.

4.8. Objectives of cluster formation initiatives

The objectives of the training initiatives clusters can be classified into six groups:

a. research and networking;

b. political action;

c. commercial cooperation;

d. education and training;

e. innovation and technology;

f. cluster expansion.

4.9. Types of cluster

The main types of clusters are presented in the following table:

Table 4.2. Types of clusters

Author	Cluster type
Markusen (1996)	***Marshalien (Network)***
	Hub and Spoke
	Satellite
	Institutional or ***state anchored*** cluster
Gordon and McCann (2000)	***Authentic agglomerations***
	Industrial
	Centered on social networks

Porter (2003), Based on US examples	***Resource dependent industries***
	Local industries
	Transactional industries
OECD (2007)	***Scientifically founded***
	Traditional
Hermans, Castiaux, Dejardin, and Lucas (2010)	***Regional***
	Global
Simmie & Hart (1999) based on the concept of Local Production Network Paradigm (LPNP)	***Cohesive Clusters***
	New Industrial Districts
	Innovative Milieux
	Proximity Clusters

(source: Tanţău et al., 2011)

4.10. Collaborative models for clusters

Cluster collaborative relations model - presents a simplified schemata of three main factors that have a significant impact on cluster specific collaborative relationships:

- cluster management;
- the reason of cooperation;
- the dominant organization within the cluster.

The organizational performance model - is based on the intensity and diversity of competition by means of cooperation relations between enterprises (e.g. the cooperation with customers and suppliers within the cluster).

Public cluster cooperation model – the coordinating structure of a public cluster is defined by a set of responsibilities assigned to various institutions in the process of shaping the policy of the cluster.

Cluster life cycle model - by analogy with the model of the product lifecycle, Sonderegger, and Taube (2010) conducted a life-cycle model of clusters (Figure 4.13).

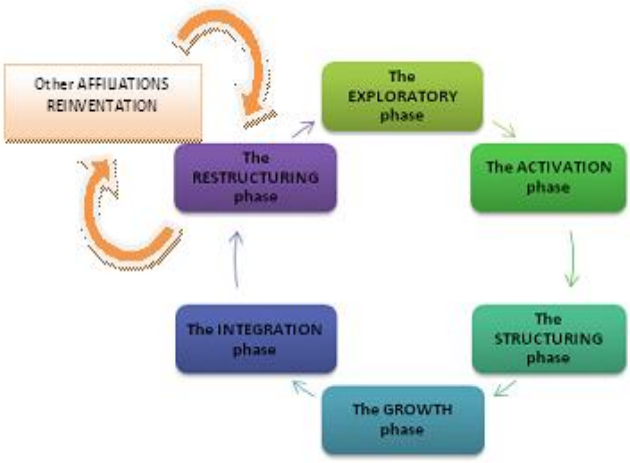

Figure 4.13. Cluster life cycle model
(adapted from Sonderegger & Taube, 2010)

4.11. Cluster policies and strategies

- **Cluster policies** - are defined as specific government efforts to support clusters. There are three types of cluster policies (Dan, 2012):
  - facilitation policies;
  - frame policies;
  - development policies.
- **National and regional strategies to support clusters**
  - National Strategy for Research, Development and Innovation 2014-2020;
  - National Strategy for Romania's Sustainable Development;
  - Regional development strategies.

4.12. Modalities to promote clusters

- **Framework Program 7 (FP7) - promotes cooperation between clusters** in the CAPACITIES program, *Regions of Knowledge* section.
- **Structural funds,** through:
  - *Operational Sectoral Program Increase of Economic Competitiveness (SOPIEC);*
  - *European Territorial Cooperation Programs.*

4.13. Cluster situation in Romania

The geographical distribution of clusters in Romania is presented in figure 4.14.

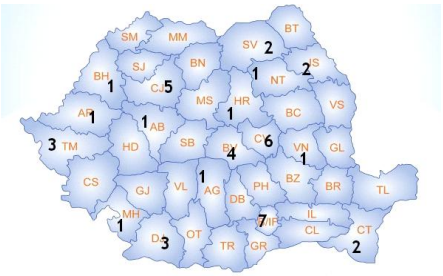

Figure 4.14. The geographical distribution of clusters
(source: http://www.minind.ro/reindustrializare/pdf/parcuri_industriale_si_clustere.pdf)

4.14. Cluster situation at European level

Their geographical distribution is presented in the following figure:

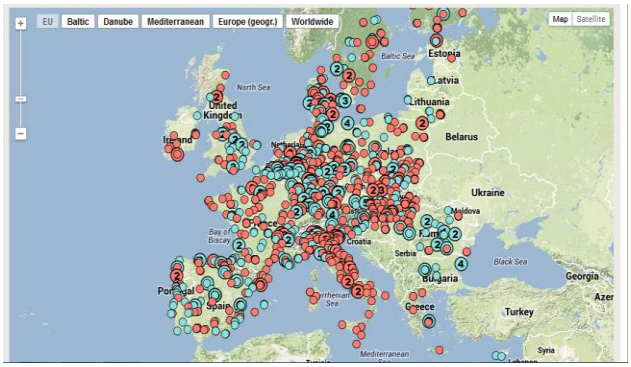

Figure 4.15. The geographical distribution of clusters at the level of the European Union
(source: http://www.clustercollaboration.eu/map)

5. CLASSICAL AND MODERN INSTRUMENTS OF QUALITY MANAGEMENT

5.1. Classical methods of quality management

- **The flow chart** - method of describing processes - is the most commonly used method for the graphical representation of the stages in a process.
- **The tabular flow chart** - allows for the immediate observation of the flow of the process, the compartments involved in the process as well as the nature of each contribution (ZERBES, 2011).
- **The cause effect diagram** - is used to identify and visualize potential causes that can lead to an effect (problems) and the representation of the relations between the possible causes of a problem.
- **The PARETO diagram** - is a graphical tool used to identify priorities for several variables or factors, based on the distribution of various effects or causes, ranked from the most frequent to the least frequent.
- **Check sheets** - simple forms for data collection specifically designed for a quick interpretation of the results.
- **Histogram** - is a graphic bar form of simple values, measured and distributed according to frequencies of emergence.
- **The dispersion diagram** - is a two-dimensional graphical representation of the relationship between two variables. This chart helps to assess the nature and degree of the relationship between the chosen variables.
- **Control charts** - are a presentation of the performance of a process over time, arranged to highlight the variation process.

5.2. Modern methods of quality management

- **Quality Function Deployment (QFD) –** meets customer requirements and offers the manufacturer or service provider the possibility to design a market-oriented product or service (Chen Ja, Jo Chen, 2002).
- **FMEA method** - Failure Mode and Effects Analysis - is an analytical method used for systematically identifying potential failures after design, manufacture or assembly of a process or service (Lobonț, 2010).
- **5 S method** - is a process of systematic improvement used to eliminate losses at the workplace through a better organization, visual communication and general cleaning (Lobonț, 2010).

6. DEVELOPMENT OF PRODUCTS AND PROCESSES

6.1. Development of products

6.1.1. The origin of new products

New products are the materialization of creativity and of the innovative capacity exhibited by large or small firms, by newly entrant entrepreneurs and other businesses that operate in various fields of production of goods and services, or their distribution and commercialization (Mitran, 2007).

6.1.2. Product life cycle

The life cycle of the product can be defined as the sequence of steps which a product undergoes, from its launch to the disappearance from the market 6.2. (Brîndaşu, Cernuşcă, 2001).

6.2. Process Development

The process is "a succession of operations, states or phenomena by which a work is achieved, or a transformation occurs; evolution, development, deployment; action".

6.2.1 Types of processes

Business processes are classified into three broad categories, namely:

- processes that convert external constraints into internal constraints (processes which determine the direction of development).
- processes that gather and prepare the necessary resources
- processes that use resources to produce results (Lobonţ, 2002).

6.2.2 Design of processes

The design of processes is considered to be the defining work of the concrete means that will be used by performers to achieve product quality objectives.

6.2.3. Process representation modalities

The main ways of representing the processes are:

- Written representation;
- Tabular representation;
- Process development map;
- Process development plan;
- Flowcharts;
- Tabular flowcharts;
- “Succession structure” method;
- Structural analysis and design technique (SADT);
- IDEF method (Integrated Definition).

7. PROCESS MODELING

7.1. Concept and advantages

The model is defined as the simplified representation of a process or system (NODEX 2002).

Using models presents a number of advantages, among which:

- the possibility of testing the sensitive points of the system;
- introducing speed changes;
- the ease of testing changes against the real system model;
- lower costs for the experiments on a model as compared to a real system.

7.2. Aim of modeling

Making a model is subject to contrary requirements to be met in a balanced manner. On the one hand, the model must be simple enough to be a representation of the real system with some degree of abstraction, and on the other hand, it should be a fairly faithful representation of the system it models.

7.3. Typology of models

In terms of typology, models can be:

- ***iconic***;
- ***symbolic*** or ***mathematical***:
  - *analytical models;*
  - *numerical models*:
    - continuous models;
    - discontinuous models.

7.4. Modeling techniques

However, these techniques can be divided into two main categories:

- static modeling;
- dynamic modeling

7.5. Types of approaches for process modeling

The following table presents the main characteristics of process modeling approaches:

Table 7.2. Types of approaching modeling techniques

Approach	Characteristics
up-bottom approach	The model of the process is built downwards, to the desired degree of detail.
bottom-up approach	It is a reverse method to approach a process.
mixed approach	There are several mixed approaches between the two approaches mentioned above.
vertical approach	The processes are deconstructed vertically, according to successive stages
stage approach	Similar to the above approach
horizontal approach	The processes are deconstructed horizontally, in several different variants.
Pareto principle	80% of a problem can be explained by 20% of its causes

(adapted from: Lobonţ, 2002; Zerbeş, 2011)

8. RESEARCH ON ACHIEVING A COLLBORATIVE MODEL OF SCIENTIFIC RESEARCH IN DEFENSE INSTITUTIONS

The initiative of forming a cluster can be defined as the organized effort to increase the growth and competitiveness of a cluster in a region, action involving a group of firms, central / local governments and academia / research.

8.1. The overall objective of this exercise is to analyze how is perceived an initiative of forming a collaborative model of scientific research in institutions in the field of defense, which would be its main coordinates, quantitative and qualitative capabilities, as well as to identify potential members.

8.2. Research objectives:

- to establish the degree of familiarity with the concept of cluster;
- to assess perceptions of the desirability and necessity of a specific cluster for defense;
- to identify the capabilities of human, technical and financial capabilities of the potential members who may participate in the formation of a collaborative cluster model;
- to assess the contribution that different types of entities may have under cluster training initiatives;
- to identify the main issues faced by cluster training initiatives;
- to outline the minimum requirements under clusters training initiatives.

8.3. Work hypotheses:

1. Familiarity with the concept of cluster and implicitly, knowledge of its characteristics and benefits of clustering, which can have a decisive role in the initiatives of cluster formation.

2. Higher education institutions are one of the main pillars of the collaborative cluster model.

3. A consistent legislation in the field can directly influence the number of cluster training initiatives.

4. Creating a specific cluster for defense is a necessity for the national economy and also to revitalize the defense industry.

8.4. Universe of population - consists of four types of cluster specific entities, namely:

- civilian universities and military institutions of higher education and civil and military research centers;
- economic agents in the sector of the defense industry as well as operators in the civilian industry, whose products / services provided are related to defense;
- central and local government authorities;
- NGOs, agencies and consultancies.

8.5. Sampling - we opted for a *non-probabilistic sampling based on a predefined goal.*

8.6. The method – the survey. The data collected by this method will be used to check all the assumptions.

8.7. Tool of inquiry - we felt that the tool that best suited our goals is the questionnaire.

8.8. Interpretation of results

Of the 30 entities selected to participate in this study, 12 of them (representing 40% of the sample) responded positively to the invitation. The types of entities and their share are shown in Figure 8.3.

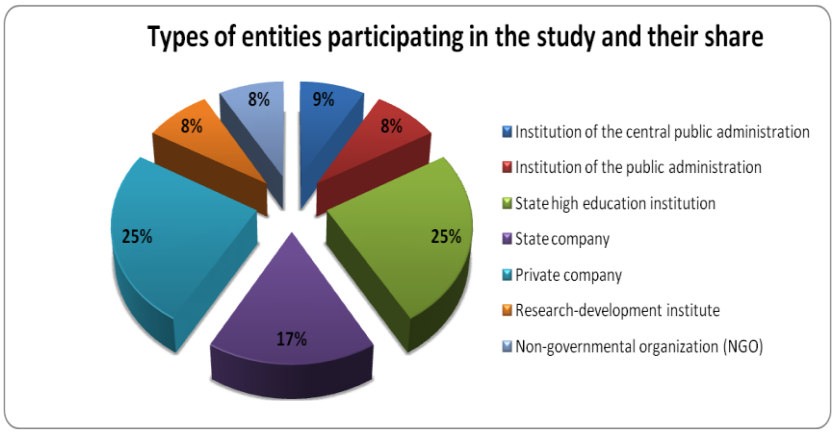

Figure 8.3. Types of entities participating in the study and their share

Referring to the familiarity with the concept of cluster (item no. 9), almost 60% of the respondents said they were familiar with this concept (Figure 8.9.).

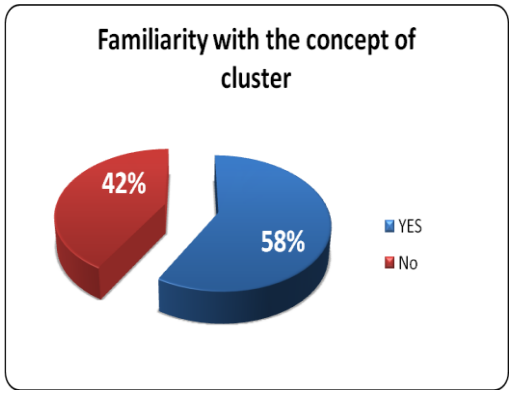

Figure 8.9. Familiarity with the concept of cluster

In what regards the issues experienced by clusters training initiatives (item no. 19), the main problem identified by the respondents was the lack of legislation, as it can be observed in the following figure:

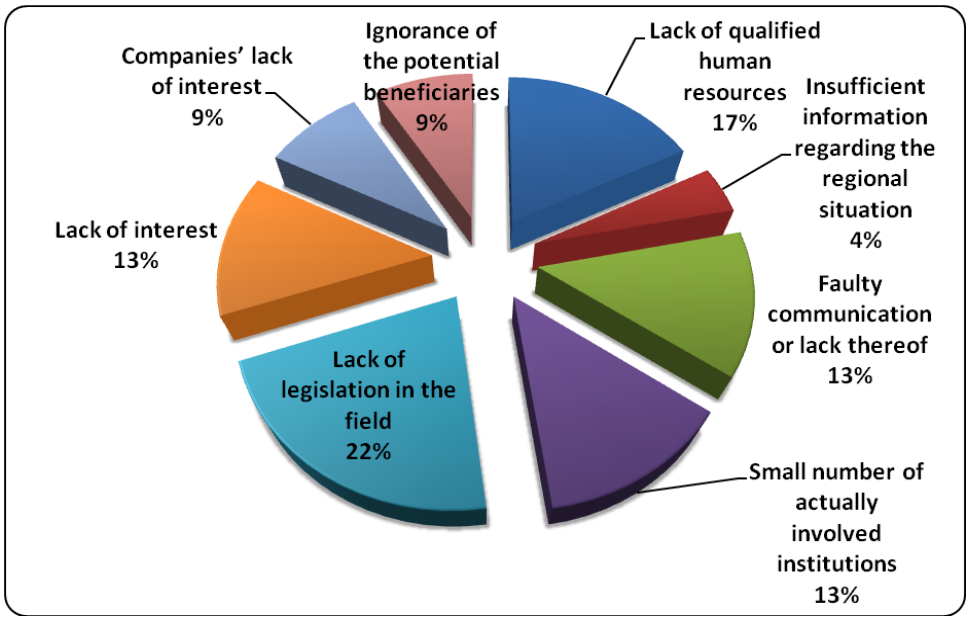

Figure 8.18. Main problems of the cluster formation initiatives

The deficiency of qualified human resources is the second problem, as reported by respondents representing business and education. Indeed, attracting skilled human resources is a problem of the whole society, but it should not be ignored that such a project can provide the specialized resources needed by each entity. Next, with an equal share, are *the reduced number of institutions that are actually involved, miscommunication or lack thereof and the lack of interest*. This last problem can be easily associated with the other two issues, namely *the ignorance of the potential beneficiaries and the lack of confidence of the companies.* This can be attributed to a lack of organizational culture related to cooperation, on account of misunderstanding or rather the lack of awareness of the benefits of collaboration. We must point out that these latter issues were raised by entities that admitted they are not familiar with the concept of cluster, and, due to this, we believe that these answers must not be taken for granted.

One of the aims of the study was to determine the capabilities of the entities to assist in the formation of clusters. When asked which attributes (in terms of strengths and weaknesses) characterize the source entities, the respondents offered the following answers, illustrated in Figure 8.23.

Thus, all respondents indicated *highly qualified human resources* as a strong point, and this in the context in which the question of the problems faced by cluster training initiatives (item no. 19), this was considered the second major issue experienced by entities, and implicitly, by these initiatives. On the second and third place was *Strong Brand* and *Organization management* and *Organization experience* with 92% and *Service and product quality* with 83%. As a weakness, *Financial resources* were indicated with 58%, followed by *Access to distribution channels*, *market share*, *Dependence on external suppliers* and *Changes in economic indicators*.

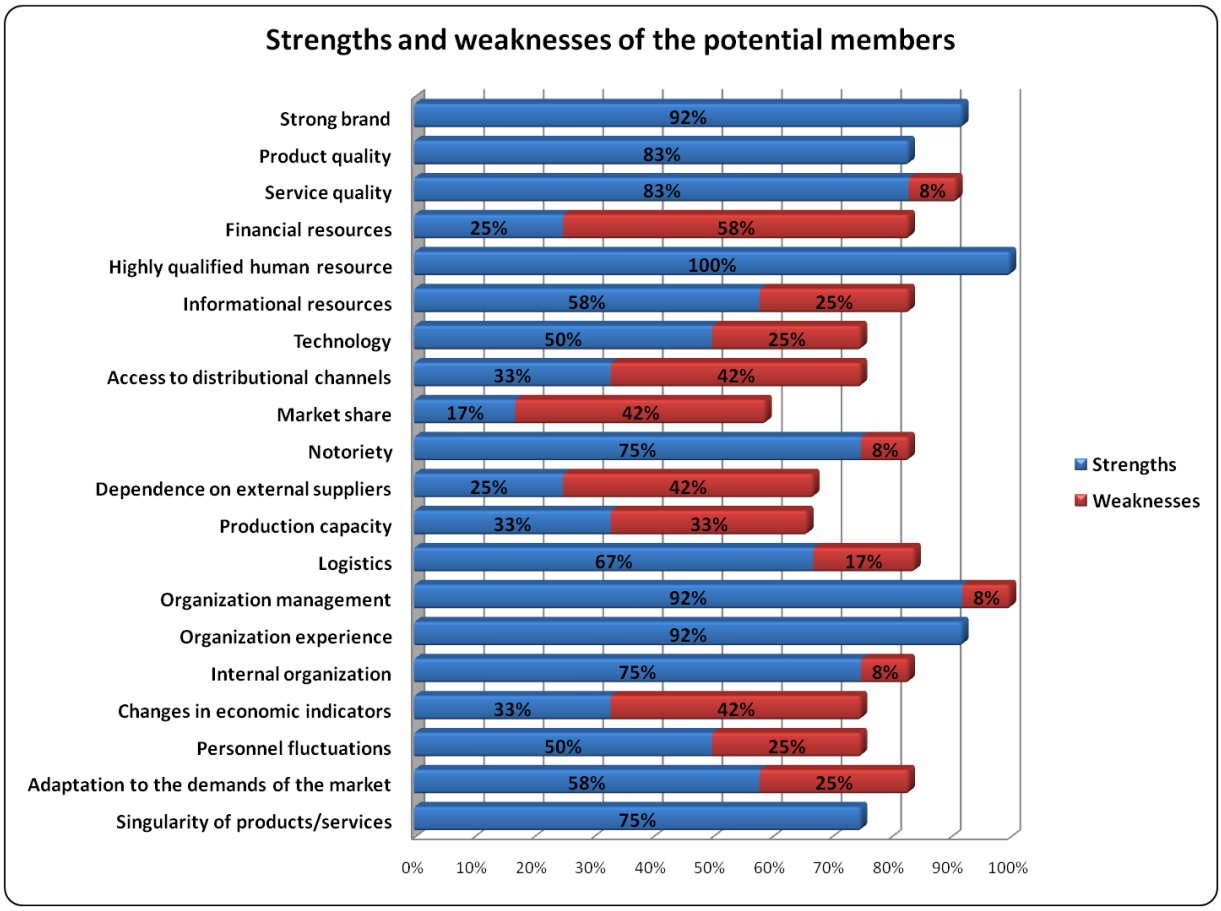

Figure 8.23. Strengths and weaknesses of the potential members

Centralizing the data that highlights the need for a specific cluster for defense (figure 8.24.) led to an expected response, namely that two-thirds of the respondents consider it is necessary to achieve such a cluster.

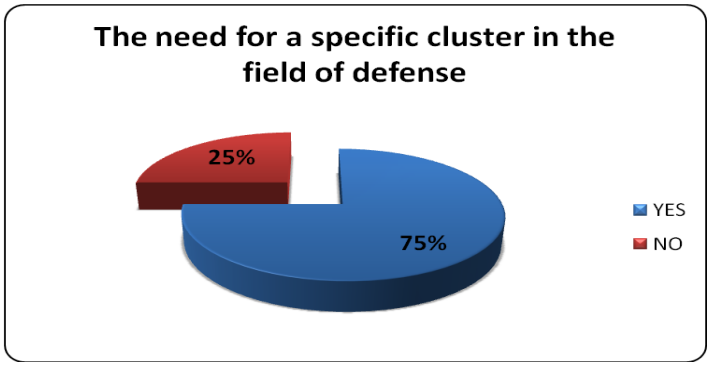

Figure 8.24. The need for a specific cluster in the field of defense

8.9. Conclusions

We believe that the hypotheses of our study were validated survey by the responses provided by the representatives of the entities that participated in this study.

Most respondents are familiar with the concept of cluster, and some of them are members of such associations. Overwhelmingly, the respondents indicated as main contributor the universities, which are both regarded as having the primary responsibility in supporting and cluster training initiatives, in a percentage of 19%. This, in conjunction with the fact that the respondents indicated that in a share of 67%, these collaborations aimed at activities specific to the RD, certifies the potential and expertise of these entities and their ability to conduct a wide range of activities.

9. COLLABORATIVE MODEL OF SCIENTIFIC RESEARCH IN DEFENSE INSTITUTIONS

9.1. Developing a collaborative model of scientific research in defense institutions using the IDEF0 method

Developing a collaborative model of research in defense institutions using the IDEF0 method constitutes a symbolic representation of the system and of all the elements contained by it.

The adopted model highlights the stages and activities comprised by it, the input data, the control elements, the mechanisms that govern the system and finally the output data.

The elaborated conceptual model (A0) is presented in figure 9.1.

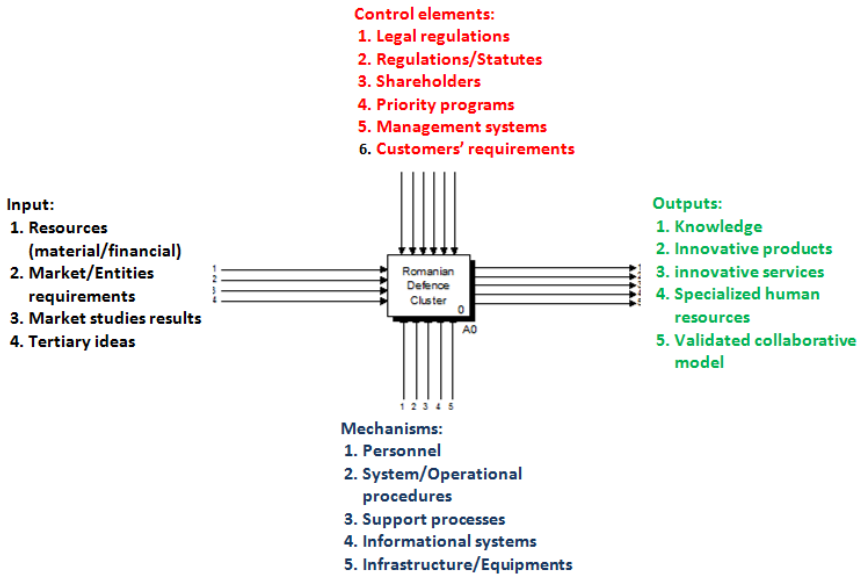

Figure 9.1. Collaborative model of the scientific research in defense institutions - *Romanian Defense Cluster*

The purpose of elaborating this model is to develop generic systems that could be used, mainly, for developing capabilities of scientific research and production specific to defense entities, and, secondly, for the increase of competition and employment , by interconnecting people, abilities, skills and knowledge.

The objective of this model is made up by the integration of the different entities in a collaborative model specific to scientific defense in the institutions in the field.

In order to develop the conceptual model, the **iGrafx 2013 v.15.0.** soft was used. The

following figure presents the menu of the application and the main stages/phases, sequentially:

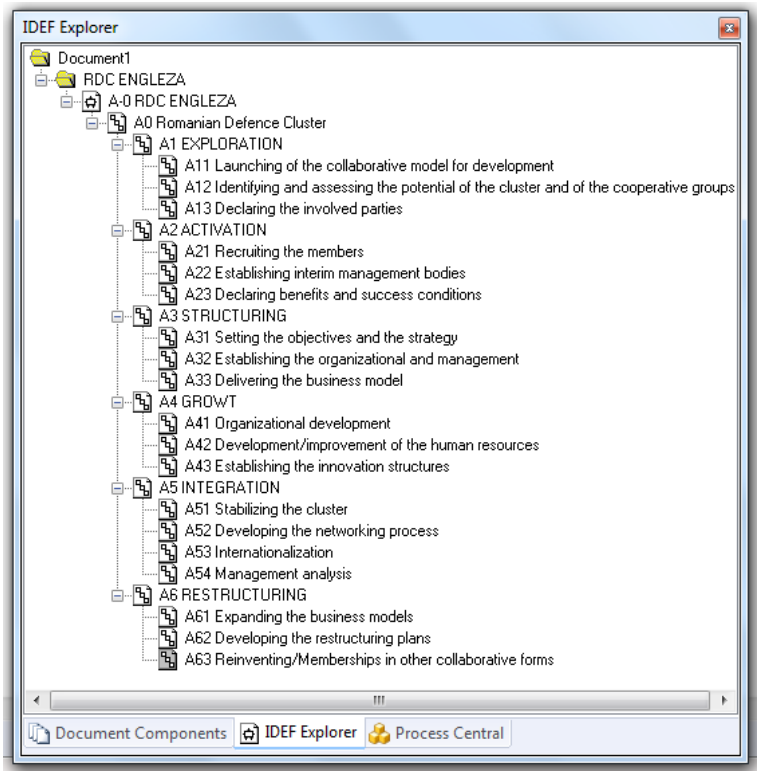

Figure 9.2. Deconstruction of the stages within the application

The first level is presented in detail in figure 9.3, showing the main stage of the collaborative model.

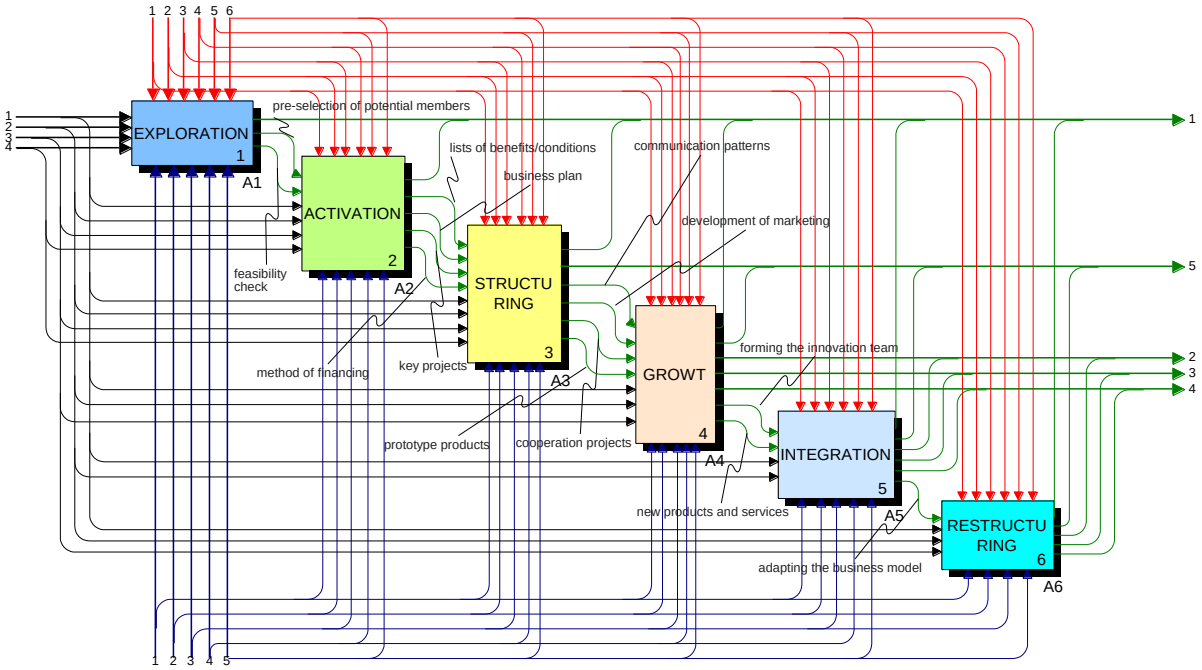

Figure 9.3. RDC collaborative model. Stages

Each of these stages / phases have been addressed as processes and broken down into individually modeled sub-processes.

The exploratory phase involves identifying and evaluating the potential of the cluster and of the cooperation groups. At this stage local opportunities are identified in order to use them to attract local resources or other factors.

In the first instance, *the activation phase* involves recruitment of members and corporations. Once the local leaders have been appointed and launched, it is required to attract a large number of partners bound in the cluster through a cooperation agreement.

The objectives and the strategy of the cluster are defined during *the structure stage*. At the same time, the necessary human and financial resources needed for a specified period are provided. The cluster begins to have a profile that is promoted through regional policy.

During the *growth stage*, and along the expansion of the network, comes the growth of the importance of its configuration in terms of organizational and human resources. Particular attention is given to the selection of the network actors, especially in promoting the innovation process. During the growth stage, innovative companies begin to create a cluster innovation system.

The integration phase can be seen as the critical point of the life cycle of the clusters, when the businesses inside the cluster have the advantage of higher flexibility and openness to new than in a hierarchical organization. Therefore, the cluster businesses can react in time to the changes in the economic environment and can make the leap into a new growth phase.

The restructuring phase marks a radical change for the cluster. The regression phenomenon of the cluster can occur, which may be due to the relocation of the actors representing the core of the cluster to better regions in terms of cost or as a result of economic events that have major effects, such as wars or crises.

There is also possible to affiliate to other collaborative forms in order to be able to adapt to market changes.

9.2. Representation of the collaborative model of scientific research in defense institutions using the tabular flowchart

In order to have a better overview on the phases, activities and processes taking place in the developed conceptual model, it is highlighted using the tabular flow diagram. In making the tabular flow diagram and in order to highlight the contribution of each of the potential members of the collaborative cluster model, we opted for the PDCA cycle as it provides a framework for improving a process or a system (Niţu, 2006).

9.3. Matrix model of the stages and activities of the collaborative model of scientific research in defense institutions

The matrix model offers the possibility of highlighting all the activities subsumed under each of the life stages of the collaborative model specific to defense. Each object corresponds to an activity and an indicator of performance, in order to provide visibility of the activities, enabling decision-makers to take action as to achieve objectives. The final version of the matrix model is presented in the section for model testing and validation.

9.4. Mathematic model of the stages and activities of the collaborative model of scientific research in defense institutions

Starting from the matrix of the collaborative model, this model can be expressed mathematically in the following format:

$$I_{RDC} = \left(\sum_{j=1}^{6} I_j^1 P_1^1 \right) r_j^1 max + \left(\sum_{k=1}^{9} I_k^2 P_k^2 \right) r_k^2 max + \left(\sum_{l=1}^{10} I_l^3 P_l^3 \right) r_l^3 max + \left(\sum_{m=1}^{4} I_m^4 P_m^4 \right) r_m^4 max + \left(\sum_{n=1}^{5} I_n^5 P_n^5 \right) r_n^5 max$$

where:

I_{RDC} - is the global indicator of the Romanian Cluster of Defense (RCD)

$I_j^1, I_k^2, I_l^3, I_m^4, I_n^5$ - is the performance index of model collaborative activities;

$P_j^1, P_k^2, P_l^3, P_m^4, P_n^5$ - is the share coefficient of the activities in the collaborative model;

$r_j^1 max, r_k^2 max, r_l^3 max, r_m^4 max, r_n^5 max$ - is the maximum risk associated with the activities of the collaborative model. It can vary from one entity to another depending on the specificity of the organization (military / civilian), organizational policy, legislative restrictions, priorities of the organization etc.

The global indicator represents the stage of development of the cluster at a specific time. It may take different values depending on the stage of development of the cluster, type, size, geographical concentration etc. The higher the value of the indicator, the more strengthened the stage of development of the cluster and its market position.

9.5. Testing and validating the elaborated collaborative model

9.5.1. Testing the collaborative model

9.5.1.1. Method and work instrument

In order to determine the values of the share coefficients and of the value of the risk of exposure associated with the activities of the collaborative model, we built an online questionnaire (Annex 3) which was distributed to the entities participating in the study, aimed at analyzing how an initiative to form a specific cluster defense is perceived; we also wanted to know the perception of the respondents regarding its main quantitative and qualitative coordinates, as well as the identification of potential members.

The questionnaire was developed using programming languages asp.net and C# (C sharp) but registration on the platform has been simplified by using a single password, valid for all respondents.

After centralizing the responses the following values of the share coefficients (Annex 4) and the exposure values (Annex 5) have been revealed.

Therefore, the matrix for the collaborative model specific to the field of defense is presented in Table 9.3.

Table 9.3. Matrix model of the stages and activities of the collaborative model of scientific research in defense institutions (final)

STAGE	OBJECTIVE	ACTIVITY	PERFORMANCE INDICATOR	SHARE COEFFICIENT
Exploration stage	Identifying potential partners	Launching the development of the collaborative model	No. of identified partners / No. of potential partners	11%
	Identifying preliminary features of the cluster	Identifying and evaluating the potential of the cluster and of the cooperation group	No. of identified features / No. of expected features	17%
	Testing the intention of the potential partners in the cluster	Market analysis	No of existing clusters / No of required clusters	19%
	Identifying the potential of the cluster	Potential analysis	Identified potential / Expected potential	15%
	Selecting of adequate partners	Pre-selection of potential partners	No. of selected partners / No. of identified partners	21%
	Obtaining information regarding the capabilities of the potential members	Checking feasibility	Identified capabilities / Predefined capabilities	17%
				100%
Activation stage	Ensuring the organizational and functional frame of the collaborative model	Recruitment of members	No. of involved partners / No. of selected partners	9%
	Procedure of election/appointment of leadership	Elaborating procedures for the election/appointment of leadership	No. of elaborated procedures	6%
	Ensuring the interim leadership	Pre-selection of cluster management	Established interim management	8%
		Pre-selection of administration board	Established interim AB	7%
	Identifying the benefits and success conditions of the cluster formation initiative	Establishing the benefits of the cluster	No. of identified benefits	11%
		Establishing the success conditions of the cluster	Established success conditions	12%
	Identifying the premises that can contribute to the development of the cluster	Developing the business plan	Elaborated business plan	15%
	Identifying defining projects for the cluster	Establishing the key projects	No. of identified key projects	16%

STAGE	OBJECTIVE	ACTIVITY	PERFORMANCE INDICATOR	SHARE COEFFICIENT
	Identifying funding sources for the cluster	Establishing the funding manner of the cluster	Available financial resources	16%
				100%
Structuring stage	Ensuring the functionality of the collaborative model	Establishing the organizational structure	No. of achieved structural elements /No. of projected structural elements	9%
	Ensuring the operational leadership of the collaborative model	Forming the management team	No. of positions occupied / No. of positions planned	10%
	Ensuring the leadership of the administrative structures	Forming the administrative team	No. of administrative positions occupied / No. of administrative positions planned	8%
	Covering the necessary HR with specialized personnel	Ensuring HR	Available personnel / Necessary personnel	10%
	Ensuring the functionality of all specific processes	Ensuring financial resources	Ensured financial resources	14%
	Implementation of the declaration of intention	Developing cluster objectives/strategies	Implemented objectives and strategies / projected objectives and strategies	13%
	Establishing the procedure for the communication methods	Establishing communications methods	Adopted methods of communication / Planned methods of ommunication	8%
	Identifying and meeting the customers' needs	Marketing development	No. of marketing campaigns achieved / No. of marketing campaigns planned	8%
	Identifying the common areas of interest for the members of the cluster	Establishing cooperation projects	No. of developed collaborative projects/ No. of expected collaborative projects	10%
	Ensuring innovative competition	Launching prototype products	No. of innovative products achieved /No. of innovative products identified	10%
				100%
	Improving organizational performance	Organizational development	No. of achieved structures / No. of planned structures	29%

STAGE	OBJECTIVE	ACTIVITY	PERFORMANCE INDICATOR	SHARE COEFFICIENT
Growth stage	Continuous personal development of the personnel	Establishing the HR development/specialized training plan	No. of courses/No. of course takers	23%
	100% specialized personnel	Specialized training of HR	No. of specialized personnel / Total no. of personnel	26%
	Ensuring innovative competition	Establishing innovative structures	Total no. of innovative structures / Total no. of structures	22%
				100%
Integration stage	Respecting all planned activities	Stabilizing the cluster	Achieved activities/Planned activities	26%
	Developing the network of contacts generating business opportunities	Elaborating the network plan	No. of achieved contacts/ No. of potential contacts	17%
	Expanding the geographical concentration of the collaborative model	Going international	Established geographical concentration	18%
	Evaluating all obtained processes and results	Management analysis	Obtained results/Estimated results	17%
	Diversifying the portfolio of offered services and products	Adapting the business model	No. of offered products/services No. of planned products/services	22%
				100%
Restructuring stage	Improving organizational and innovative economic competition performance	Expanding the business models		
		Developing restructuring plans		
		Reinventing		
		Affiliations with other forms of collaboration		

9.5.1.2. Experimental application of the mathematical model

In order to test the mathematical model it is necessary to identify performance indicators specific to the collaborative work model. These indicators cannot be identified at this time, not even by the entities participating in the formation of the cluster, because these values can differ from one entity to another and, most importantly, can be identified only after the completion of the activities. Thus, starting from the idea that our model is a conceptual model, we will assign hypothetical values of these indices.

By replacing the formula with the values of the share coefficients specified in the matrix model (shown in Table 9.3.), risk exposure values (listed in Annex 5) and the values assigned to the performance index, the following formula has emerged:

$$I_{RDC} = \left(\frac{11}{100}\cdot\frac{12}{30}+\frac{17}{100}\cdot\frac{5}{10}+\frac{19}{100}\cdot\frac{0}{0}+\frac{15}{100}\cdot\frac{3}{10}+\frac{21}{100}\cdot\frac{1}{1}+\frac{17}{100}\cdot\frac{20}{25}\right)\cdot 3+$$

$$\left(\frac{9}{100}\cdot\frac{1}{1}+\frac{6}{100}\cdot\frac{1}{1}+\frac{8}{100}\cdot\frac{1}{1}+\frac{7}{100}\cdot\frac{1}{1}+\frac{11}{100}\cdot\frac{2}{1}+\frac{12}{100}\cdot\frac{3}{1}+\frac{15}{100}\cdot\frac{1}{1}+\frac{16}{100}\cdot\frac{3}{1}+\frac{16}{100}\cdot\frac{1}{1}\right)\cdot 6+$$

$$\left(\frac{9}{100}\cdot\frac{2}{6}+\frac{10}{100}\cdot\frac{10}{50}+\frac{8}{100}\cdot\frac{5}{25}+\frac{10}{100}\cdot\frac{10}{50}+\frac{14}{100}\cdot\frac{1}{1}+\frac{13}{100}\cdot\frac{1}{1}+\frac{8}{100}\cdot\frac{1}{11}+\frac{8}{100}\cdot\frac{2}{5}+\frac{10}{100}\cdot\frac{1}{5}+\frac{10}{100}\cdot\frac{1}{2}\right)\cdot 6+$$

$$\left(\frac{29}{100}\cdot\frac{2}{6}+\frac{23}{100}\cdot\frac{2}{10}+\frac{26}{100}\cdot\frac{10}{50}+\frac{22}{100}\cdot\frac{1}{6}\right)\cdot 4+\left(\frac{26}{100}\cdot\frac{3}{10}+\frac{17}{100}\cdot\frac{10}{20}+\frac{18}{100}\cdot\frac{1}{1}+\frac{17}{100}\cdot\frac{15}{20}+\frac{22}{100}\cdot\frac{15}{20}\right)\cdot 4=$$

$$\frac{13}{25}\cdot 3+\frac{167}{100}\cdot 6+\frac{2559}{5500}\cdot 6+\frac{347}{1500}\cdot 4+\frac{1271}{2000}\cdot 4=\frac{289943}{16500}=17{,}57\overline{230}\cong 18$$

9.5.1.3. Conclusions

In our example, the overall index value () of the RDC collaborative cluster model reflects the development stage at the moment, depending on the stage of development of each participating entity, correlated with the stages of the cluster life cycle.

In time, this value can have different values depending on the actual value of the performance indicators specific to each entity and on the organizational development needs of the entities. All this can be influenced by the peculiarities of each organization, by the domain expertise, the profile of the entity (civilian / military), by a number of internal and / or external factors etc.

9.6. Validating the developed collaborative model

To validate the model, we present the correlation between the most important features (available data) of three identified clusters (EDEN France, IT Cluj Romania, Transylvania PrelMET) plus the collaborative model Romanian Defense Cluster (RDC).

The EDEN cluster is a French cluster that brings together the leading French defense companies and not only. The peculiarity of this cluster is that it has an inter-regional dimension, each region being represented by entities of the same type.

Cluj IT Cluster is perhaps the most well known cluster in our country and probably the

most active. It is a regional cluster composed of active organizations in the field of information technology.

The PrelMET Transylvania cluster is an emerging cluster constituted in an area with strong traditions in metalworking. We opted for this cluster because some of the entities that compose it come from several companies in the defense sector.

The main features considered are listed in the following table:

Table 9.4. Main characteristics of clusters

	EDEN France	Cluj IT Romania	PrelMET Transylvania	RDC
Dimension	81	41	27	12
Civilian enterprises	62	29	15	3
Authorities/Management agencies	8	8	8	2
Employees	6500	3629	481	6450
Fiscal figure - 2013	650.000.000 €	175.092.740 €	102.253 €	7.000.000 €
Global indicator of the cluster	122	62	41	18

Correlation is a statistical method used to determine the relationships between two or more variables and the correlation coefficient is a quantitative value that describes the relationship between two or more variables. It varies between -1 and +1, where the extreme values assume that there is a perfect relationship between variables, while 0 means a complete lack of linear relationship. The most widely used is the Pearson correlation coefficient (r) for normally (uniformly) distributed values and Spearman correlation coefficient (rs) for unevenly distributed values.

The Pearson correlation coefficient (r) is an independent unit of measure. It evaluates the degree of association between two variables. The following table can be used to interpret the value of the Pearson correlation coefficient:

Table 9.5. Interpretation of the Pearson factor

Interval of the Pearson correlation coefficient (r)	Interpretation of the Pearson coefficient
[0; 0.2]	very weak intensity correlation
[0.2; 0.4]	weak intensity correlation
[0.4; 0.6]	reasonable correlation, of average/moderate intensity
[0.6; 0.8]	high intensity correlation
[0.8; 1]	very high intensity correlation

For the analysis of bi-variate correlation, we have executed the following sequence of commands: *Analyze → Correlate → Bi-variate → Bi-variate Correlations* window after which we obtained information about the Pearson coefficient shown in Table 9.6., for the variables *"Cluster dimension"* and *"Fiscal value",* respectively in table 9.7. for the variables *"Civilian Enterprise"* and *"Fiscal value".*

Table 9.6. Pearson correlation factor of the variables ”Cluster dimension” and ”Fiscal value”

		Cluster dimension	Fiscal value
Cluster dimension	Pearson Correlation	1	,973*
	Sig. (2-tailed)		,027
	N	4	4
Fiscal value	Pearson Correlation	,973*	1
	Sig. (2-tailed)	,027	
	N	4	4

Table 9.7. Pearson correlation factor of the variables ”Civilian enterprises” and ”Fiscal value”

		Fiscal value	Civilian enterprises
Fiscal value	Pearson Correlation	1	1,000*
	Sig. (2-tailed)		,019
	N	4	4
Civilian enterprises	Pearson Correlation	1,000*	1
	Sig. (2-tailed)	,019	
	N	4	4

In Tables 9.6. and 9.7. we obtained the matrix of the correlation coefficients, the values being distributed on each side of the diagonal of the tables. The correlation coefficients equal to 1 represent the correlation of each variable with itself, while on the other diagonal of the tables we found the values of the correlation coefficient between the variables.

9.6.1. Conclusions

1. The correlation displayed in tables 9.6. and 9.7. is bi-variate, one of the variables being dependent and the other independent (factorial). *Pearson correlation coefficient* equals 0.973, 1.000 respectively, which means that there is a linear, positive (direct), very intense correlation between the analyzed variables. The evolution of the clusters during their life cycle is very strongly linked to the evolution of fiscal value and to the collaboration with civilian enterprises.

2. The model called "*global indicator of the cluster*" is validated by the fact that it correlate with real, measurable elements, verifiable by established methods.

10. GOVERNANCE - CONCEPT, TYPOLOGY, PRINCIPLES, MODELS

10.1. The concept of governance

Studies on the concept of governance focus on five defining aspects, namely:

1. Governance refers to a set of institutions and actors involved, but not part of the government;

2. Governance identifies the blurring of the boundaries and responsibilities for addressing social and economic issues;

3. Governance identifies the power dependence manifested in the relationships between the institutions involved in collective actions;

4. Governance refers to autonomous self-governing networks of actors.

5. Governance recognizes the capacity to do and achieve things that are not based on the government's ability to use authority.

- **Terminological and conceptual delimitations**

Governance means developing a set of rules, procedures and practices for configuring the way in which executive power manifests, in other words the way in which political power in a state is exercised;

Leadership consists of direction and coordination, according to certain rules and principles of the actions for the implementation of decisions;

Management is to implement the objectives that eventually produce the expected results;

Governance consists of the leadership and management supervision (Dobrotă Cocean, Bogdan, Bucur, Balăceanu Agachi, Herbil, 2011).

- **Characteristics of governance** - governance has 8 major characteristics. It is *participatory, consensus oriented, accountable, transparent, responsive, effective and efficient, equitable and favorable to inclusion, and follows the rule of law*.
- **Principles of European governance** - they set the rules, processes and behaviors through which power is exercised at European level, namely: *Openness, Participation, Accountability, Effectiveness and Coherence*.
- **Levels of application of European governance -** they are:
  - strategic;
  - functional;
  - project level.
- **Corporate governance** - specifies the distribution of rights and responsibilities of different categories of persons involved in the company: Board of Directors, directors, shareholders and other categories and establishes rules and procedures for decision-making on a company's activity." (OECD, 2004).

- **Principles of corporate governance** – a set of principles aimed at:
  - providing a framework for the effective implementation of corporate governance;
  - the rights of shareholders;
  - equitable treatment of shareholders;
  - the role of stakeholders;
  - disclosure and transparency.
- **Collaborative governance** - is a sum of expectations, interactions, and not finally of responsibilities which offer the only realistic option to address the multiple economic, social and environmental challenges today's society is facing.

10.2. Governance of the collaborative model of scientific research in defense institutions

The governance system of the collaborative model specific for defense can be illustrated by grouping its components on three levels, namely:

- **Structures** - can be of two types:
  - *Interior*:
    - General Meeting of Shareholders (GMS);
    - Council of Administration (CA);
    - Strategic Council;
    - Scientific Council.
  - *External* – regulating authorities.
- **Procedures** - represented by all the acts regulating the activity of the organization / institution.
- **Behaviors** – represent the way to act and react in certain circumstances or situations (DEX, 2009). In this case we consider the specific behaviors of top management (managers, executives, administrators etc.)

10.2.1. Internal structures of the collaborative model of scientific research:

- General Meeting of Shareholders (GMS);
- The Board of Directors (BD);
- Strategic Council;
- Scientific Council.

10.2.2. Specific procedures of the collaborative model

The main document underlying cluster operation is the Statute.

In order to detail the tasks or activities a range of domestic regulatory actions such can be developed at the level of the cluster, such as the ***Code of Business Conduct and Ethics.***

Another category of internal regulatory norms are ***Procedures***.

10.3. Cannibalization of the market and human resources

Cannibalization is defined as a negative consequence resulting from the extension of the default product line. The new product will compete and eventually *eat* the profits of the

existing product, hence the name of cannibalization.

A particularly sensitive area for the operation of the cluster is that of human resource. Signs of cannibalizing human resources might appear amid the development of collaborative projects. In our view, this can be avoided by the establishment and adoption by all cluster members of a set of rules regarding hiring and the responsibilities of the personnel involved in such projects, as well as the compliance by the management of each entity with a transparent and balanced staff policy.

11. ANALYSIS AND EVALUATION OF THE RISK OF THE COLLABORATIVE MODEL

11.1. Theoretical approaches of risk

Most frequently risk is perceived as "a phenomenon that arises from circumstances for which the decision-maker is able to identify possible developments / events and even the probability of their production (materialization), without being able to specify exactly which of these events will actually occur (Păun & Păun, 1999).

The most accepted formula for risk quantification is:

Risk = **probability** (of production) X **impact** (of the event)

11.2. Risk typology

a. *according to the size of the impact*:

- *strategic risk;*
- *operational risk.*

b. *according to the origin of risk*:

- *external risk*;
- *internal risk*.

c. *according to the nature of activity*:

- *legislative;*
- *legal;*
- *material;*
- *financial;*
- *social;*
- *environmental;*
- *informational* etc.

11.3. Risk management - overview

Risk management can be considered a matter of general interest that, assimilated into other organizational initiatives, will contribute to improved decision-making and contribute significantly to transition towards results-based management.

Risk management consists of (M 75/2012):

- ***Identification of the risks*** - risks are identified and defined in relation to the aims whose achievement is affected by them.
- ***Assessment of the risk*** - refers to assessing the likelihood of risks materializing and their impact on the objectives.
- ***Establishing risk tolerance*** - the amount of risk that an organization / structure is prepared to tolerate or that it is willing to be exposed at a time.
- ***Risk mitigation strategy*** - risk response. We include: acceptance; avoidance; continuous monitoring; transfer and mitigation of risks.
- ***Reviewing and reporting risks*** - consists of:
  - monitoring changes of risk following the implementation of internal control / managerial tools;
  - obtaining assurance on the effectiveness of risk management and identifying the need to take further measures.

11.4. Implementing risk management of the collaborative model

Along with the domestic measures taken by each of the entities forming the collaborative model regarding the implementation of risk management, the Cluster Management Board will appoint a Commission of for managing specific aspects of internal /management control (MIC). The main task of the MIC committee is to develop the ***Risk strategy***, a document stipulating the manner in which the organization will adopt regarding risks.

The share of risk exposure values specific to the collaborative model is shown in the following table:

Table 11.7. Share of risk exposure values

Level of risk exposure	No. de risks	%
Low	-	-
Medium	14	87,50 %
High	2	12,20 %

These data lead us to conclude that the tolerance limit of the collaborative model is a medium which requires the design and implementation of short or medium term control measures.

12. CONCLUSIONS, PERSONAL CONTRIBUTIONS AND DIRECTIONS OF RESEARCH

12.1. Conclusions

In a time when a *globalized defense industry* and the establishment of structures for joint forces at regional and European level are increasingly spoken about, it is particularly difficult to talk about the future of national defense or the possible role and / or place that it will have in a defense industry established at European level.

We believe that cluster type collaborative models are the instrument that best meets the current challenges of the current socio-economic and politico-military millieux. And this all the more since achieving the future defense industries established at European level, which I mentioned earlier, must be based on the adoption of policies and smart solutions of achieving weapon systems in strict accordance with resizing national defense structures .

Thus, the proposed model performed using the IDEF methodology captures all the essential aspects needed to run the specific activities of a defense cluster under optimal conditions.

This methodology can detail and customize the functions of the model and the relations between them, in order to meet the most stringent demands of the potential entities participating in cluster training initiatives.

Last but not least, highlighting the aspects of governance and risk management, approached from the perspective of the achieved model, led to the development of the cluster governance model, the development of the drafts of the basic documents required to establish the main procedures governing the collaboration between entities within this association, establishing risk tolerance etc., which are meant to guide and simplify any initiative of forming such an entity, but also to ensure an easy practical implementation of such a collaborative model.

In our view, implementing such a collaborative model can significantly contribute to:

- concentrating efforts and capabilities in order to implement projects;
- revitalizing the national defense industry;
- an efficient use of resources;
- increasing the quality of the processes carried out;
- reducing the dependence of the decision-makers on the services of experts due to the fact that the elaborated collaborative model has as first result the establishment of a knowledge base that can be accessed in case of need;
- ensuring timely response to the frequent changes in the business environment;
- integrated promotion nationally and internationally;
- ensuring consistency, continuity and dynamism specific to collaborative projects;
- improving relationships with customers and stakeholders etc.

12.2. Personal contributions

Among the main contributions of the research to the development of knowledge in the field, we can mention:

1. Critical analysis of the performance of scientific research in military higher education institutions of intelligence, public order and national security;
2. Presentation of the evolution and critical analysis of the RD system specific to the defense;
3. Analyze and systematize information on the objectives and scientific research management structures within NATO and EDA (European Defense Agency)
4. Analyze, structure and present in an original manner the issue of collaboration in research - concept, sizes, shapes, typology, and variables.
5. Analyze and systematize information on clusters;
6. Comparative analysis of the state of cluster development in Romania and Europe;
7. Summary of quality management techniques and tools;
8. Develop an overview on the development of products and processes;
9. Develop an overview on process modeling;
10. Develop of two online questionnaires used to analyze the manner in which is perceived an initiative to form a specific cluster for defense, respectively the validation of the conceptual model;
11. Critical analysis of the way in which an initiative to form a specific cluster for defense is perceived;
12. Develop the conceptual graphic model of the scientific research collaborative model in institutions of defense using the IDEF0 method;
13. Develop the conceptual matrix model of the stages and activities of the scientific research collaborative model in institutions in the field of defense;
14. Design objectives and performance indicators for the phases in the scientific research collaborative model in institutions in the field of defense;
15. Develop the conceptual graphic model (as tabular flow chart diagram) of the scientific research model collaborative in institutions in the field of defense;
16. Develop the mathematical model of the phases and activities of the scientific research collaborative model in institutions in the field of defense;
17. Pilot the developed conceptual model;
18. Model the matrix of the scientific research collaborative model in institutions in the field of defense;
19. Mathematical modeling of the scientific research collaborative model in institutions in the field of defense;
20. Mathematical simulation of the scientific research collaborative model in institutions in the field of defense;

21. Analysis of the results obtained from the simulation;
22. Validation of the collaborative model specific to defense;
23. Develop a conceptual governance model of the collaborative model;
24. Develop (draft) of the Constitutive Act of the Association of Romanian Defense Cluster;
25. Develop (draft) of the Statute of the Romanian Defense Cluster Association;
26. Develop a conceptual model of risk management specific to the collaborative model;
27. Develop (draft) the Risk Register of Romanian Defense Cluster;
28. Develop (draft) Risk Map of the Collaborative Model Romanian Defense Cluster.

During the development of the program and doctoral thesis, between 2012-2015, I published a number of 9 scientific papers (8 papers as first author and one paper as co-author), as follows: 5 articles published in BDI indexed journals in the country and abroad, and 4 papers presented at international conferences (Proceedings of these events are being evaluated for ISI CPCI indexing).

At the same time, I was part of the research project *Soft Education in Ethics and Military Leadership,* LCD - *Interactive Scenarios of Virtual Action in Problematic Situations from the Perspective of Ethics and Military Leadership*, project funded under the Sectoral Plan for Research and Development of the Ministry of Defense in 2015.

12.3. Possible directions of research

Aware of the fact that the results of this research approach have not covered the entire area of the issue addressed, we believe that studies can be taken forward through:

- Presentation of the developed model to the structure in charge of managing scientific research in the MoD (AD) to analyze the benefits and opportunities of implementing such a model;
- Identification of dual-use technologies and products that can be part of the cluster portfolio;
- Initiating research that will conduct to the increase of the cluster life cycle
- Identification of the manner in which the principles of *Smart Specialization* can be applied in defense;
- Development of studies containing data resulting from piloting the model, studies to be presented at scientific meetings, thus achieving the academic validation of the developed conceptual model.

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Annex 4

Values of the share coefficients

STAGE	ACTIVITY	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	Medium value	FINAL value
EXPLORATION	Launching the development of the collaborative model	15	15	5	10	10	10	10	10	0	30	5	10	10,83333333	11
EXPLORATION	Identifying and evaluating the potential of the cluster and of the cooperation group	30	15	5	10	20	30	20	20	2	10	20	20	16,83333333	17
EXPLORATION	Market analysis	20	15	15	20	20	10	20	15	20	30	25	20	19,16666667	19
EXPLORATION	Potential analysis	15	15	5	20	20	20	20	15	10	10	25	10	15,41666667	15
EXPLORATION	Pre-selection of potential partners	10	20	60	20	20	20	10	25	30	10	10	20	21,25	21
EXPLORATION	Checking feasibility	10	20	10	20	10	10	20	15	38	10	15	20	16,5	17
ACTIVATION	Recruitment of members	5	10	10	10	20	5	10	15	5	2	5	10	8,916666667	9
ACTIVATION	Elaborating procedures for the election/appointment of leadership	10	10	5	5	10	5	10	5	5	2	5	5	6,416666667	6
ACTIVATION	Pre-selection of cluster management	10	10	5	5	10	5	10	10	5	5	10	5	7,5	8
ACTIVATION	Pre-selection of administration board	5	10	5	5	10	5	10	10	5	1	10	5	6,75	7
ACTIVATION	Establishing the benefits of the cluster	10	10	10	15	20	10	10	10	10	5	10	15	11,25	11
ACTIVATION	Establishing the success conditions of the cluster	15	10	20	10	10	10	10	10	20	5	15	10	12,08333333	12
ACTIVATION	Developing the business plan	15	10	10	20	10	10	10	10	10	30	20	25	15	15
ACTIVATION	Establishing the key projects	15	15	20	20	5	20	10	15	20	30	15	10	16,25	16
ACTIVATION	Establishing the funding manner of the cluster	15	15	15	10	5	30	20	15	20	20	10	15	15,83333333	16

STRUCTURING	Establishing the organizational structure	20	10	5	5	10	5	10	5	10	5	10	5	8,333333333	9
STRUCTURING	Forming the management team	10	10	10	5	10	5	10	15	10	10	10	10	9,583333333	10
STRUCTURING	Forming the administrative team	5	10	5	5	10	10	5	10	10	10	10	5	7,916666667	8
STRUCTURING	Ensuring HR	5	10	15	5	10	10	10	20	10	10	5	10	10	10
STRUCTURING	Ensuring financial resources	10	10	30	10	10	10	10	20	10	20	5	20	13,75	14
STRUCTURING	Developing cluster objectives/strategies	10	10	5	30	15	20	10	5	10	10	15	20	13,33333333	13
STRUCTURING	Establishing communications methods	15	10	5	10	10	5	5	5	10	5	10	5	7,916666667	8
STRUCTURING	Marketing development	10	10	5	10	15	5	10	5	5	10	10	5	8,333333333	8
STRUCTURING	Establishing cooperation projects	10	10	5	10	5	15	20	5	15	10	10	10	10,41666667	10
STRUCTURING	Launching prototype products	5	10	15	10	5	15	10	10	10	10	15	10	10,41666667	10
GROWTH	Organizational development	20	25	55	25	15	35	35	15	20	20	35	50	29,16666667	29
GROWTH	Establishing the HR development/specialized training plan	30	25	25	25	30	15	15	35	30	20	15	15	23,33333333	23
GROWTH	Specialized training of HR	30	25	10	25	30	10	25	35	40	20	30	25	25,41666667	26
GROWTH	Establishing innovative structures	20	25	10	25	25	40	25	15	10	40	20	10	22,08333333	22
INTEGRATION	Stabilizing the cluster	10	20	70	20	30	15	25	20	20	10	35	35	25,83333333	26
INTEGRATION	Elaborating the network plan	25	20	10	20	30	30	15	15	20	5	5	5	16,66666667	17
INTEGRATION	Going international	15	20	5	20	15	25	20	15	20	30	20	10	17,91666667	18
INTEGRATION	Management analysis	20	20	10	20	10	10	20	25	10	35	15	15	17,5	17
INTEGRATION	Adapting the business model	30	20	5	20	15	20	20	25	30	20	25	35	22,08333333	22

Legend: R1 ÷ R12 represent the respondents

Annex 5.

Risk exposure values

IDENTIFIED RISK	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	RISC
Incorrectly sized potential as compared to the available potential	2	0	2	1	4	9	1	1	1	6	2	1	**3**
Faulty establishment of the capabilities of the collaborative model	3	0	2	1	6	9	2	4	4	2	1	1	**3**
Faulty procedure of the organizational processes	3	0	2	2	6	4	2	1	6	6	1	2	**3**
Elaboration of an unrealistic business plan	2	0	2	2	6	9	4	9	6	6	2	2	**4**
Not assigning the financial resources	6	0	9	6	6	9	2	4	6	4	4	4	**6**
Inadequate sizing of the administrative structures	4	0	2	1	2	9	1	4	2	1	1	2	**3**
Inadequate sizing of the management structures	3	0	2	3	2	9	1	1	1	6	1	2	**3**
Assuming unrealistic objectives	3	0	3	2	4	9	1	2	4	6	1	1	**3**
Low impact of marketing campaigns	4	0	9	4	4	9	1	1	4	2	1	1	**4**
Deficit of HR	2	0	9	3	6	9	4	6	1	6	2	1	**4**
Deficit of financial resources	2	0	9	3	6	9	6	4	3	6	4	4	**6**
Insufficient specialization of the personnel	2	0	6	3	9	9	2	4	3	2	4	1	**4**
Development of inefficient innovative structures	3	0	4	6	4	4	2	4	2	4	4	1	**3**
Insufficient development of the contact network	1	0	6	4	9	9	1	1	4	6	1	1	**4**
Erroneous interpretation of results	2	0	6	2	6	9	1	4	4	4	2	2	**4**
Lack of adaptation of the business model to the market tendencies	3	0	6	6	6	9	1	1	6	6	6	2	**4**

Legend: R1 ÷ R12 represent the respondents
Yellow color is specific to medium risks
Red color is specific to high risks.