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STRATEGIC ANALYSIS FOR RESEARCH VIRTUAL TEAMS. THE CASE OF INPRO RESEARCH NETWORK

Anca DRAGHICI[1], George DRAGHICI[1]

[1] Politehnica University of Timisoara, Integrated Engineering Research Centre, {adraghici, gdraghici}@eng.upt.ro

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Abstract: Market globalization has instituted an environment of uncertainty and continuous change for all organizations. They have been forced to implement rapid, dynamic, flexible structures and agile teams or groups, known as virtual teams. The paper presents important issues for establishment the strategic plan for a research virtual team development and debate the case of INPRO network. The main aspects discussed are: (1) the strategic analysis methodology development and implementation. In this context two aspects will be debated: short overview of the SWOT strategic diagnosis method, and key concepts and discussions of value chain analysis as an analytical and policy tool; (2) strategic analysis in the case of Romanian Research Network for Integrated Product and Process Engineering (INPRO); (3) in the final part of the paper, some conclusions will be presented regarding the research efficiency and target. A new organization of the research system can only lead to a clearer vision of the research orientations, an improvement of the quality of research by exploiting complementarities, avoiding duplication, and finally a better impact on our industry for the good health of our society.

1. INTRODUCTION

In today's challenging global market, organizations must innovate to survive. Business innovation must occur in all dimensions (product, process, and organization) to improve competitiveness and business performance [1, 3]. To differentiate themselves, enterprises must capture, manage, and leverage their intellectual assets. Strategy has to be developed and implemented in a dynamic way and by taking into consideration the organization itself and the external environment dynamics. Most of the organizations have developed virtual works because of the information and communication technology. Virtual teams are groups of geographically and/or temporally dispersed individuals brought together via information and telecommunication technologies [4, 5, 6]. Virtual teams are increasingly becoming a key feature of projects in modern organizations, while the landscape of communication tools continues to change dramatically [3].

The above items have contributed to important changes in the scientific research – development – innovation activity. Virtual work have becomes an important way of product and processes development, and for collaborative processes in networks. Also, the efficiency and effectiveness of this virtual research networks have to be quantified and pilot. The development of such groups or networks strategy of has to be established on a realistic diagnosis (based on the total resources use evaluation and their impact) and its implementation consequences has to be the targets attending [4].

In this paper are analyzed the main aspects in formulating the strategic plan of a virtual research network. The main aspects that will be discussed are: (1) the strategic plan methodology development and implementation. In this context two aspects will be debated: short overview of the SWOT strategic diagnosis method, and key concepts and discussions of value chain analysis as an analytical and policy tool; (2) strategic plan development and implementation based on the case of Romanian Research Network for Integrated Product and Process Engineering (INPRO); (3) in the final part of the paper, some conclusions will be presented regarding the efficiency and effectiveness of the research.

2. THEORETICAL ISSUES OF THE STRATEGIC ANALYSIS

2.1. Auditing the strategic position of the organization and its environment using the SWOT analysis model

SWOT analysis is a simple framework for generating strategic alternatives from a situation analysis. Because it concentrates on the issues that potentially have the most impact, the SWOT analysis is useful when a very limited amount of time is available to address a complex strategic situation. In Figure 1 is shown the diagram of a SWOT analysis that fits into a strategic situation analysis.

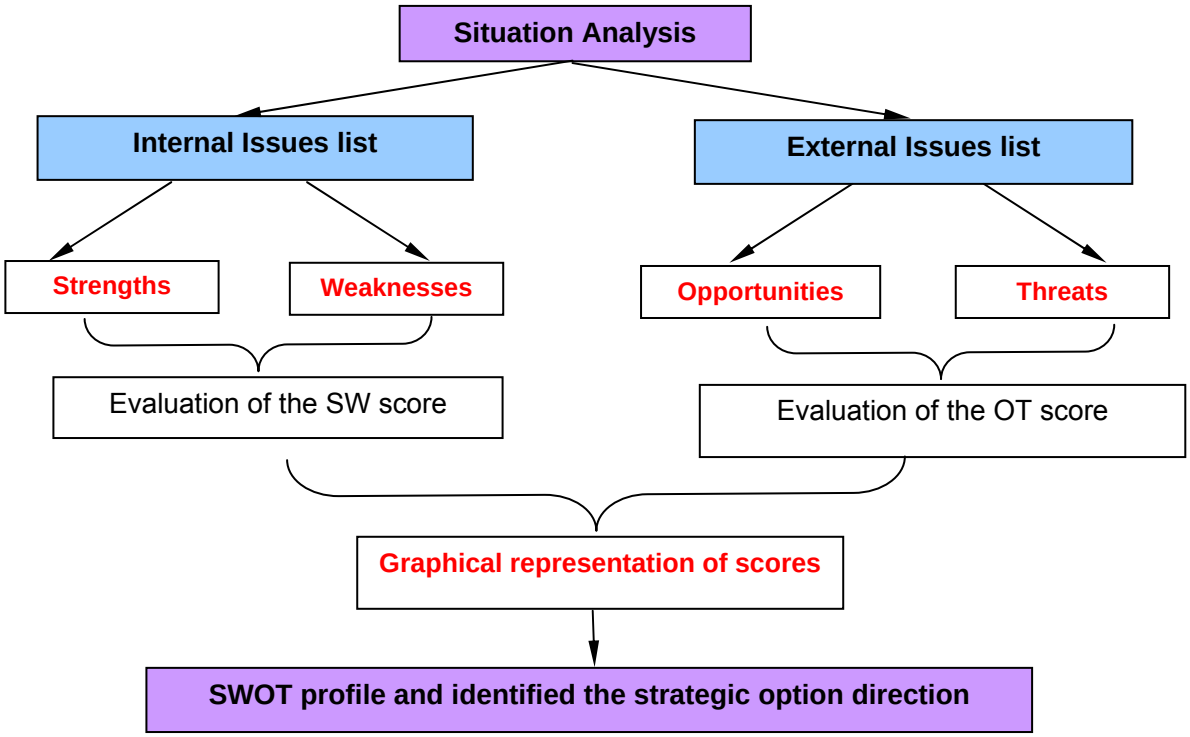

Figure 1. The methodology for establish the SWOT profile

The internal and external situation analysis can produce a large amount of information, much of which may not be highly relevant. The SWOT analysis can serve as an interpretative filter to reduce the information to a manageable quality of key issues. The SWOT analysis classified the internal aspects of the organization as strengths or weakness and the external situational factors as opportunities or threats. Strengths can serve as a foundation for building a competitive advantage and weaknesses may hinder it. By understanding these four aspects of its situation, an organization can better leverage its strengths, correct its weaknesses, and capitalize on golden opportunities and deter potentially devastating threats.

Internal analysis is a comprehensive evaluation of the internal environment's potential strengths and weaknesses. Factors should be evaluated across the organization in areas such as: organization culture; organization image; organizational structure; key staff; access to resources; position on the experience curve; operational efficiency; operational capacity; brand awareness; market share; financial resources; exclusive contracts; patents and trade secrets.

For each affirmation (*K*) from the S and W list can be associated points (weights) by comparison analyzing of each of them with the others. The weight of each factor *K* can be calculated using the following formula:

$$p_j = \frac{\sum_{i=1}^{n} K_{ij}}{\sum_{j=1}^{t}(\sum_{i=1}^{n} K_{ij})} \quad (1)$$

Taking into consideration the determinate weight of each factor we allocate point "n_j" from 1 to 10 on a scale that has 0 as a median point. The S factor's points will be consider with "+" and the W factor's points will be consider with "-". Based on these we can calculate the result on the SW axe.

$$x = \sum_{j=1}^{n} p_j \times n_j \quad (2)$$

External analysis - An opportunity is the chance to introduce a new concept, process, product or service that can generate superior returns. Opportunities can arise when changes occur in the external environment. Many of these changes can be perceived as threats to market position of existing products and may necessitate a change in product specifications or the development of new products in order for the organization to remain competitive. Changes in the external environment may be related to: customers; competitors; market trends; suppliers; partners; social changes; new technology; economic environment; political and regulatory environment.

For each affirmation (*K*) from the O and T list can be associated points (weights) by comparison analyzing of each of them with the others. The weight of each factor *K* can be calculated using the following formula 1. Taking into consideration the determinate weight of each factor we allocate point "n_j" from 1 to 10 on a scale that has 0 as a median point. The O factor's points will be consider with "+" and the T factor's points will be consider with "-". Based on these we can calculate the result on the OT axe.

$$y = \sum_{j=1}^{n} p_j \times n_j \quad (3)$$

Graphical representation of the *x* and *y* scores allowed us to determine the SWOT profile and to identify the strategic option direction.

For data collecting and establishing the strength, weakness, opportunities and threats lists there can be used a questionnaire and for the weight of each factor in the analysis can be develop brainstorming sessions with different kind of participants.

Tabelul 1. Qualitative matrix for the strategic variants as a result of the SWOT analysis

	S – List of strength:	**W –** List of weakness:
O - List of opportunities:	**SO** max – max type	**WO strategy** min – max type
T – List threats:	**ST strategy** max – min type	**WT strategy** min – min type

2.2. Key concepts and discussions of the value chain analysis

The Value Chain framework of Michael Porter is a model that helps to analyze specific activities through which firms can create value and competitive advantage. The value chain describes the activities that take place in a business and relates them to an analysis of the competitive strength of the business. Value chain analysis is one way of identifying which activities are best undertaken by a business and which are best provided by others ("out sourced"). What activities a business undertakes is directly linked to achieving competitive advantage. In accord with the Michael Porter proposed mode the activities of the value chain are:

a. Primary activities (line functions):

- **Inbound Logistics** includes receiving, storing, inventory control, transportation planning;
- **Operations** includes machining, packaging, assembly, equipment maintenance, testing and all other value-creating activities that transform the inputs into the final product;
- **Outbound Logistics** - the activities required to get the finished product at the customers: warehousing, order fulfillment, transportation, distribution management;
- **Marketing and Sales** - the activities associated with getting buyers to purchase the product, including: channel selection, advertising, promotion, selling, pricing, retail management etc.
- **Service** - the activities that maintain and enhance the product's value, including: customer support, repair services, installation, training, spare parts management, upgrading etc.;

b. Support activities (Staff functions, overhead):

- **Procurement** of raw materials, servicing, spare parts, buildings, machines etc.;
- **Technology Development** includes technology development to support the value chain activities. Such as: Research and Development, Process automation, design, redesign;
- **Human Resource Management** - the activities associated with recruiting, development (education), retention and compensation of employees and managers;
- **Organization's Infrastructure** includes general management, planning management, legal, finance, accounting, public affairs, quality management etc.

The primary and support activities as shown in the following model:

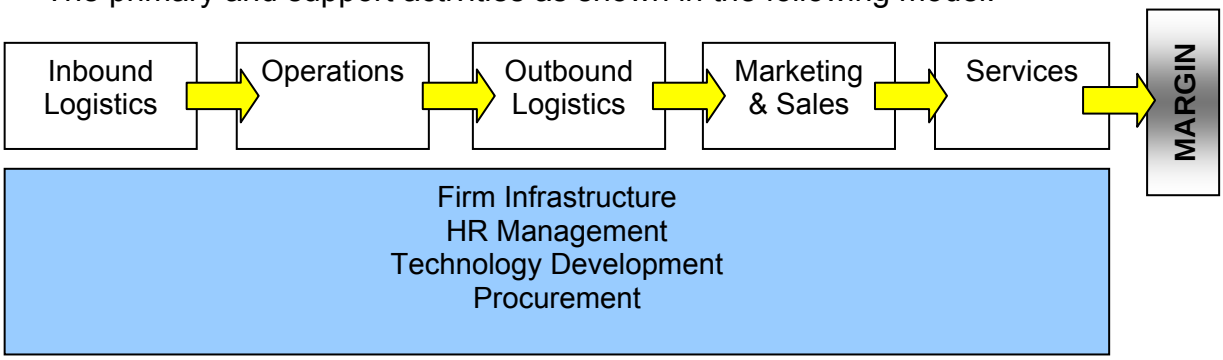

Figure 2. Porter's Generic Value Chain

The organization's margin or profit then depends on its effectiveness in performing these activities efficiently, so that the amount that the customer is willing to pay for the products exceeds the cost of the activities in the value chain. It is in these activities that an organization has the opportunity to generate superior value. A competitive advantage may be achieved by reconfiguring the value chain to provide lower cost or better differentiation [4]. The value chain model is a useful analysis tool for defining an organization's core competencies and the activities in which it can pursue a competitive advantage as follows:

a. Cost advantage by better understanding costs and squeezing them out of the value-adding activities. An organization may create a cost advantage either by reducing the cost of individual value chain activities or by reconfiguring the value chain. Once the value chain is defined, a cost analysis can be performed by assigning costs to the value chain activities. The costs obtained from the accounting report may need to be modified in order to allocate them properly to the value creating activities. Porter identified 10 cost drivers related to value chain activities: economies of scale; learning; capacity utilization; linkages among activities; interrelationships among business units; degree of vertical integration; timing of market entry; firm's policy of cost or differentiation; geographic location; institutional factors (regulation, union activity, taxes etc.). An organization develops a cost advantage by controlling these drivers better than do the competitors. A cost advantage also can be pursued by reconfiguring the value chain. Reconfiguration means structural changes such a new production process, new distribution channels, or a different sales approach.

b. Differentiation by focusing on those activities associated with core competencies and capabilities in order to perform them better than do competitors. A differentiation advantage can arise from any part of the value chain. For example, procurement of inputs that are unique and not widely available to competitors can create differentiation, as can distribution channels that offer high service levels. Differentiation stems from *uniqueness*. A differentiation advantage may be achieved either by changing individual value chain activities to increase uniqueness in the final product or by reconfiguring the value chain. Porter identified several drivers of uniqueness: policies and decisions; linkages among activities; timing; location; interrelationships; learning; integration; scale (e.g. better service as a result of large scale); institutional factors. Many of these also serve as cost drivers. Differentiation often results in greater costs, resulting in tradeoffs between cost and differentiation. There are several ways in which an organization reconfigures its value chain in order to create uniqueness. It can forward integrate in order to perform functions that once were performed by its customers. It can backward integrate in order to have more control over its inputs. It may implement new process technologies or utilize new distribution channels. Ultimately, the organization may need to be creative in order to develop a novel value chain configuration that increases product differentiation.

3. STRATEGIC ANALYSIS CASE STUDY

3.1. Brief overview of the establishment context of INPRO organization

The **INPRO** – **Romanian Research Network for Integrated Product and Process Engineering** was developed in the context of the CEEX national program in 2006. The project joint 121 members (73 PhD, 37 PhD. students, 9 researchers and 2 master students) from 9 research centers, localized in the Universities of Timişoara, Bucureşti, Iaşi, Braşov, Bacău, Suceava, Sibiu and Oradea and a research national institute. They have decided to share their competencies and knowledge in the field of integrated engineering. The project proposal is based on the idea of linking the Romanian scientific

research to the European research using the bridge created by the participation of **Politehnica University of Timisoara** (the leader of the proposed project), by the **Integrated Engineering Research Centre** (CNCSIS certificate no.103/2001) in the **Network of Excellence** (NoE) **Virtual Research Lab for a Knowledge Community in Production** (VRL-KCiP), financed by the **6th Framework Program** (FP6) of the European Commission, **contract no. NMP2-CT-2004-507487**. In NoE VRL-KCiP, the partners have the mission to create and develop **national research networks**, to sustain their integration process in the European network, for the development of the **European Research Area**. This objective was attended by setting up the national research network in the field of Integrated Engineering (INPRO). Also, it derive from the need of reducing research fragmentation in the field, for building of a common material and human base that assure the possibility for complex researches in modeling and simulation of product and manufacturing, and processes associated with their life cycle. It will be create a dynamic structure and a collaborative platform in integrated design that will allows its members to participate in collective design projects with industrial applications. The share information process needs the information change into knowledge. Their variety is from the determination of the product specification to the life cycle end, including the processes and the manufacturing systems design. The integration process inside the network will be the base for the communication system development between the partners and for the knowledge community establishment. The proposed project answer the requests of the FP7 European Commission program for building a **Europe based on the knowledge society principles** [2, 7].

3.2. INPRO virtual research organization's objectives

The complex project INPRO attend strategic objectives in high scientific-technical (S/T) development through: critical mass concentration (at national level) of human resources and materials (equipment) of high value, in the field of integrated engineering of products and processes in Romania and link them at the European Research Areas (ERA) priorities, objectives and specific activities. The human and material resources allocation in the S/T thematic fields of the project proposal are proved by the partners' competencies and their research results.

The General Strategic Objectives [2] – The project sustains research and development activities that include fundamental, applicative researches of pre-competitive level and which are made together by the INPRO network's partners. This following: integration, increasing quality and performance activities; development of a long time partnership between the partners and regional research centers establishment: South Pole (Bucharest), East Pole (Iasi-Suceava-Bacau), Central Pole (Brasov-Sibiu), and West Pole (Timisoara-Oradea). The regional research centers will concentrate the scientific research and the human and material resources of high performance from their region, by taking into account their local specific/conditions but, also, for their adapting and integration at the national level. At the regional centers there will be installed visioconferences systems that allowed communication and knowledge share in an operative manner.

The project proposal aims to associate some representative research teams in the field of integrated engineering from the universities: Timisoara, Bucharest, Iasi, Bacau, Suceava, Brasov, Sibiu and Oradea and a national research institute, in a consortium of specialists which have decided to share their competencies and knowledge. This consortium will become a representative research centre of excellence for a new research model and for a new system for resources using. It will contribute to the knowledge development as requested by the national strategy for the scientific research development

(established by the CEEX) and by the European strategy for ERA creation. The necessity of the INPRO network establishment is a solution for reducing fragmentation in the field of research and for building a joint research base. That will facilitate complex research development in product and processes modeling and simulation by the joint effort of the partners. This is the creation context of a dynamic structure and a collaborative integrated design platform that allowed the members to participate at the joint research projects.

The Specific Strategic Objectives [2] are:

- Setting up a manufacturing knowledge base in the field of product and processes integrated engineering;
- Increasing research activities performance, stimulating the specialized research team foundation in the priority R&D fields and facilitating the access to the EU research programs;
- Enhancing of the human resources education process by including the young PhD. students in the joint research activities and by assure the access to the disseminating activities in the INPRO network and the connection with VRL-KCiP European;
- Facilitating the mobilities inside the INPRO network and the European network VRL-KCiP;
- Superior valorization of the existing material research base and research cost reduction by creating the possibility to common use of the partners' extant infrastructure;
- Managerial skills development in the scientific research field and increasing the capacity for new financial resources identification.

Considering the holistic approach, the research activities have to be developed by combining fundamental research with the applicative one. The capacity of solving design and production problems, supporting the industrial dynamic processes will determine the consolidation of the INPRO network position and it becomes the best partner for industry. Progressive creation of a common knowledge base and of the reliable structure of the network will allowed us to increase the implication in industrial partnerships which will assure network viability and will strength its' scientific prestige. Small and medium enterprises (SME) will be more and more interested in the collaboration with the research networks. INPRO wish to be implicating in the technology transfer, knowledge dissemination and research results evaluation.

The INPRO project brings a contribution to attend the strategic objective at a high level of S/T knowledge development considering **3 conjugated objectives** [2]:

I. Creation, consolidation and development of the INPRO network;
II. Initiation and development of jointly executed research activities;
III. Spreading of excellence.

3.3. Auditing the strategic position of the INPRO organization

Based on the described methodology (point 2.1) there have been formulated a plan for a primary strategic diagnosis of the virtual research organization. This action has been developed in the first year of the project (September – December 2006) based on the partners contributions.

In the first step of the approach there have been established the INPRO's mission, vision and objectives (they have been explained to all the partners, too). For attending the objectives an action plan have been defined (including stages, activities, deadlines and quantifiable results). This action plan was imagine for 3 years: 2006 – 2008, was adept and implement by all the partners involved in the project.

For the strategic diagnosis there have been define a questionnaire (for collecting the S, W, O and T issues) during a workshop organized in Brasov, August 2006, and a brainstorming session was initiated for final discussions and conclusions. Also, the research hypotheses were defined during the workshop discussions.

The main result of the diagnosis was the SWOT strategic profile and the strategic options that have to be followed for the next years (2007 and 2008) of the project. Each partner has defined initially, his own strategy and finally the individual strategies were harmonized and integrated in an unique direction.

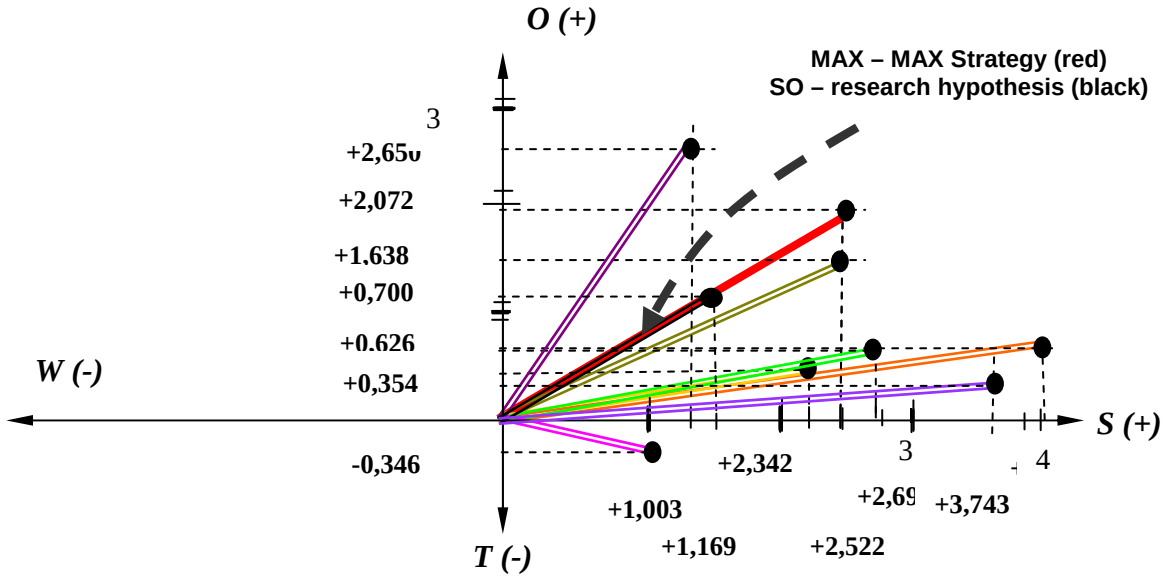

Figure 3. The cumulate representation of the SWOT profiles (for all the partners) and the INPRO integrated SWOT profile (one color for each partner)

The diagnosis was practically based by the input from seven teams involved in the project (the most representatives). The followed strategy (as a research result) will be an aggressive one – the strengths will be valorized, well used and integrated (from each partner and from the whole network) to obtained a market advantage and a well known prestige of the organization (at the national and international level). This ambitious strategy is based on synergy creation between partners in the research, development and innovation activities that were planed to be developed.

The implementation of the strategy was followed by a control plan that was established by INPRO's coordinator and was accepted by all the partners. Also, this control plan was accompanying by the whole activity and financial report conducted by the National Authority AMCSIT from Bucharest.

The INPRO organization's research results and management has been very good appreciated during the second and the third years of the project (2007 and 2008) not only by the National Authority AMCSIT, but also by the scientific community (as events like papers presentation in the national and international conferences).

3.4. Strategic analysis of the INPRO virtual research network

In 2007, during the second year of the project and the INPRO organization development (in the network consolidation phase) the top management representatives have initiated a new strategic analysis as a result of the strategy up-date need. The adopted methodology was the value management as was described in the 2.2 section.

The main idea of this approach was to underline the organization total value maximization (the invested capital, intellectual capital and material capital) and the added-value creation. This was a big challenge because of the specificity of the INPRO organization - virtual network for research, development and innovation. In figure 4 is shown the basic model that define our approach (the Porter's model adapted to the particular case of the virtual research network INPRO).

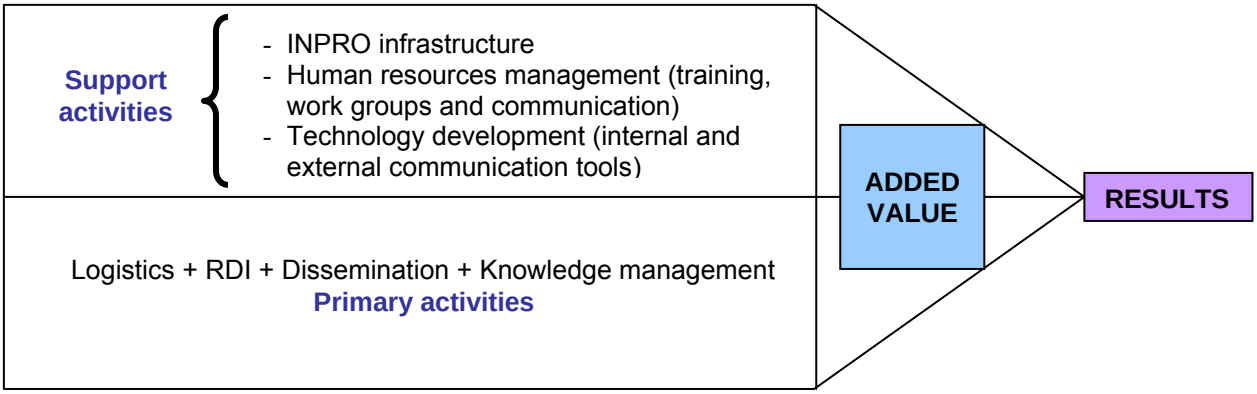

Figure 4. The value chain analysis in the case of INPRO organization

The value chain analysis was completed by the management through results method because of the National Authority AMCSIT constrains for each financial stage of the project.

The support and primary activities were described by the data collected (in accord with the described items in Figure 4) from all the partners involved in the INPRO research network. There were mentioned the financial resources used (by each partner and by the coordinator) for each item presented in Figure 4. In 2006 and 2007:

- The total budget of the support activities was approximately 46500 Euro;
- The total budget of the primary activities was approximately 57000 Euro.

For the precisely characterization of the organization's added value creation, there have been centralized all the results obtained by each partner as: product models, contributions to the collaborative research platform (infrastructure development that can be used for scientific and didactical purposes; the knowledge map and the members competencies capitalization), articles, books and patents published by the network's members.

The above analyze was developed by each partner and then to the whole organization (bottom – top approach). The research has identified partners with significant results (they are very good added value creators) but there are, also passive partners that do not understand the research activities orientation and their implication in the project.

The strategic plan of the INPRO research network, for 2008 (the final year of the National Authority AMCSIT financial support) was established based on the above analyzes and it consist some models regarding the partners integration for the increasing of the research-development-innovation activities dynamics. In this context the strategic plan for the future development of the organization is defined by [3, 4]:

- The **market integration policy** – suppose the diminishing and the elimination of the artificial barriers in the knowledge change process by similar RDI policies of the partners and by common policies and strategies formulating;
- The **institutional integration policy** – implicate partners common interventions in the creation, development and the use processes of the collaborative research platform INPRO (including the videoconference system) and the harmonization of

the education programs (master and PhD programs) by the syllabus content improving where is possible;
- The **integration through investments** – supposes strategic alliances or collaborations in the filed of RDI for the collaborative research platform INPRO up-date and for future projects in the European Research Area and in the national space, too.

4. CONCLUSIONS

The establishment and development of a virtual team in the field of research is a challenge situation. It was proved that such organizations have the potential to realize additional process gains and deliver high-quality solutions by bringing together diverse individuals with complementary knowledge without the limitations of physical, organizational or cultural boundaries [1]. The competitive environment places a premium on the quality and speed of solutions, and technology is providing increasingly richer collaboration tools – advancing from the telephone and the fax machine to video conferencing and virtual workspaces (defined by Internet and Intranet). Also, organizations that learn to harness the power of virtual teams with these collaborative technologies will gain significant competitive advantage [3].

In this context, the present paper has debated the case of the Romanian virtual research network INPRO. Based on representative references, we have provided comprehensive state-of-the-art documentation about strategic analysis development using the SWOT and value chain models. After a short overview of the establishment context of the organization there have been presented the objectives of this virtual research network. Finally, for the same organization there were described two strategic analysis processes:

I. The strategic auditing using the SWOT analysis model (that was developed in the initial phase of the INPRO organization's establishment), and
II. The strategic analysis based on the value chain model (that was developed in the maturity phase of the INPRO organization's development).

The main purpose of this approach was the management optimization of the virtual organization and the development of common research activities oriented to the creation of the multi-site collaborative working platform linked to the product life cycle management (PLM) concept (including the associated processes). Through the partners' integration policy this representative result of the INPRO virtual research network will be created and tested during the last financial phase of the project (2008) and it will be the base of the future collaboration with industry.

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