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CAROTS
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CARO Business Model



CAROTS

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The report is compiled according to the Partnership agreement between the lead partner and UNECON (St. Petersburg, Russia) for the implementation of the project # R076 CAROTSoF Interreg Baltic Sea Region.

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Abstract

Validity hypothesis **confirmed** about the formation of a **new technological transfer institute in the SME format** – Commercial Analytical Research Organizations (CARO) – providing services in various fields. CAROs will help enterprises to benefit from knowledge and potential of scientists and research facilities in the Baltic Sea Region (BSR). They will facilitate access of companies to research infrastructures (RI) and to scientific expertise needed to solve analytical tasks in areas like e.g. New Materials, NanoTech or Life Sciences and thus significantly expedite innovation.

Three types of CARO are identified that have a number of common and differentiating building blocks in the business model:

1. "R&D": invest in laboratory equipment, perform custom and initiative (own) research. The latter are positioned as their own innovative projects. The core competency – R&D;
2. "Service": provide engineering services (modeling, prototyping, engineering, measurements, testing, access to RI etc.) for start-ups that implement innovative projects. Own innovation projects do not initiate. The core competency is a professional engineering service;
3. "Consulting": provide innovative management services (management of innovative projects, search for financing, consulting, marketing research, business planning etc.) for start-ups that implement innovative projects. They can implement their own innovative projects, join a consortium with start-ups, etc. The core competency is innovative entrepreneurship.

Based on the results of the interview, the CARO business model is proposed, Table 1.

Table 1. CARO business model.

| Pillar | Building Block of Business Model | CARO Type | | |
|---------------------------|----------------------------------|-----------------------------------|-----------------------|--|
| | | R&D | Service | Consulting |
| Product | Value Proposition | "Niche" specialized R&D & service | | Reducing the «transaction costs» of the innovation process |
| Customer Interface | Target Customer | | Researchers, startups | |
| | Distribution Channel | Industry | | |
| | Relationship | Networking (sci, prof, etc) | | |
| Infrastructure Management | Value Configuration | Labs & Researches | | Fundraising opportunities |
| | Capability | Own Labs & Researches | | Staff |
| | Partnership | University / Industry / Gov | Sci networks | Innovative and scientific grant funds |
| Financial Aspects | Cost Structure | Fixed assets (labs equipment) | | Staff & marketing |
| | Revenue Model | R&D payment / grants | Service payment | Management fee |

Introduction

Problem. Bridging the «Death Valley», «Innovation Gap» remains as a problem in the development of markets, primarily in the high-tech sector.

Self-organization of the subjects of the innovation process leads to the evolution of the institutional structure of technological transfer.

A hypothesis is expressed about the formation of a new technological transfer institute in the SME format – Commercial Analytical Research Organizations (CARO) – providing services in various fields. CAROs will help enterprises to benefit from knowledge and potential of scientists and research facilities in the Baltic Sea Region (BSR). They will facilitate access of companies to research infrastructures (RI) and to scientific expertise needed to solve analytical tasks in areas like e.g. New Materials, NanoTech or Life Sciences and thus significantly expedite innovation.

Hypothesis 1: CARO was formed as a promising institute of technological transfer, increasing the effectiveness of the conversion of R&D results to commercial innovations.

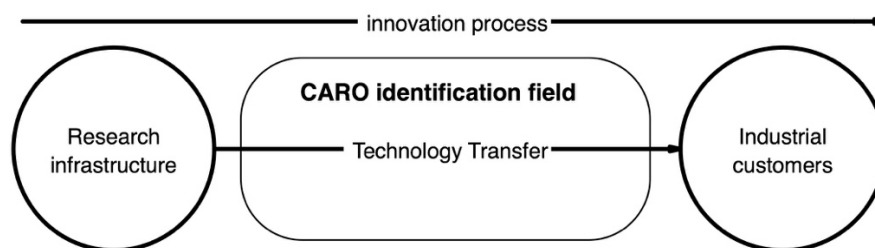


Fig. 1. CARO identification field.

Hypothesis 2: There are a limited number of types of CARO business models that can be defined and replicated.

Purpose: Highlight an effective CARO business model, which could be addressed to organizations of this type to improve their competitive position.

According to the purpose, the following sequential research **objectives** are formulated:

- Choose a methodological platform for developing a CARO business model;
- Examine samples of hypothetical CAROs according to (building) blocks of the business model;
- Classify CARO according to the variability of building blocks business models;
- Develop business models for the selected CARO types.

Definition of Terms

Business model is a conceptual tool that contains a set of elements and their relationships and allows expressing a company's logic of earning money. It is a description of the value a company offers to one or several segments of customers and the architecture of the firm and its network of partners for creating, marketing and delivering this value and relationship capital, in order to generate profitable and sustainable revenue streams (*Osterwalder*).

CARO is a profit-seeking organisation acting as an intermediary between research infrastructures and industrial customers, providing support, consultation, analytical research and measurement services in the field of new materials/material sciences (including engineering), Life Science/BioTech, NanoTech and CleanTech on a contractual basis. *¹CAROs have to be private companies and for-profit. (*The project documentation #R076 CAROTS of Intereg Baltic Sea Region*)

CleanTech is any process, product, or service that reduces negative environmental impacts through significant energy efficiency improvements, the sustainable use of resources, or environmental protection activities. Clean technology includes a broad range of technology related to recycling, renewable energy, information technology, green transportation, electric motors, green chemistry, lighting, Greywater, and more (*Gaddy et al*).

Intellectual Property is a term referred to types of property that result from creations of the human mind (the intellect). In a broadly sense, it comprises patents, copyright and related rights, trade marks, know how, trade secrets, industrial designs, designs, drawings, reports, methods of research and developments, documented data, and description of inventions and discoveries (JRC Science Hub Communities / *The European Commission's science and knowledge service*).

Life Science/BioTech – EU economy can classify into three broad groups: healthcare and pharmaceutical applications: agriculture, livestock, veterinary products, and aquaculture, industrial processes and manufacturing (*Communication from the Commission to the Council, the European Parliament*);

NanoTech is a field of applied sciences and technologies involving the control of matter on the atomic and molecular scale, normally below 100 nanometers. Nanomaterials may exhibit different physical and chemical properties compared with the same substances at normal scale, such as increased chemical reactivity due to greater surface area (*European Commission Decision C (2020)1862 of 25 March 2020*).

Research infrastructure means facilities, resources and related services that are used by the scientific community to conduct top-level research in their respective fields and covers major scientific equipment or sets of instruments; knowledge-based resources such as collections, archives or structures for scientific information; enabling Information and Communications Technology-based infrastructures such as Grid, computing, software and communication, or any other entity of a unique nature essential to achieve excellence in research. Such infrastructures may be “single-sited” or “distributed” (an

¹ Included according to «CARO Industry Overview. Report. [draft version] Grönlund, Mikko, Laiho, Taina, Ranti, Tuomas, Stenvall-Virtanen, Sari, Head of Education, UTU, 2020».

organised network of resources) (*European Commission: Legal framework for a European Research Infrastructure Consortium – ERIC Practical Guidelines*).

Technology Transfer can be described as the successful application and/or adaptation of a technology developed in one organisation to meet the needs of one or more other organisations. The transferred technology shall be innovative for the recipient. A technology transfer not only includes transfer between organisations but also between different industrial sectors. A technology transfer is deemed to have been achieved once a licensing agreement, a joint venture agreement, a manufacturing agreement, and/or a commercial agreement with technical assistance has been signed (JRC Science Hub Communities / *The European Commission's science and knowledge service*).

Abbreviations

| | |
|------|--|
| BM | Business model |
| CARO | Commercial Analytical Research Organizations |
| IP | Intellectual Property |
| RI | Research infrastructure |
| TT | Technology Transfer |
| SME | Small and medium-sized enterprises |

Design of the Study

Methodology

The methodological platform for the development of the CARO business model was selected² *Osterwalder model (2004)*, including 9 Building Block (4 Pillar), tabl. 2.

The uniqueness of CARO as an institutional structure of technological transfer can be found in the difference in the content of building blocks from other (traditional) specializations of subjects in innovative processes. Variability in the content of building blocks will reveal the classification of CARO types.

Table 2. Business model description structure according to *Osterwalder*³.

| Pillar | Building Block of Business Model | Description |
|------------------------------|----------------------------------|---|
| Product | Value Proposition | A Value Proposition is an overall view of a company's bundle of products and services that are of value to the customer. |
| Customer In- terface | Target Customer | The Target Customer is a segment of customers a company wants to offer value to. |
| | Distribution Channel | A Distribution Channel is a means of getting in touch with the customer. |
| | Relationship | The Relationship describes the kind of link a company establishes between itself and the customer. |
| Infrastructure Management | Value Configuration | The Value Configuration describes the arrangement of activities and resources that are necessary to create value for the customer. |
| | Capability | A capability is the ability to execute a repeatable pattern of actions that is necessary in order to create value for the customer. |
| | Partnership | A Partnership is a voluntarily initiated cooperative agreement between two or more companies in order to create value for the customer. |
| Financial As- pects | Cost Structure | The Cost Structure is the representation in money of all the means employed in the business model. |
| | Revenue Model | The Revenue Model describes the way a company makes money through a variety of revenue flows. |

Research Method

Information gathering (stage 1) for the search for building blocks CARO business models based on:

² This Report does not describe the theoretical background and the rationale for choosing an approach to developing a business model. The process of analysis and selection of the type of business model for CARO is presented in scientific articles by Alekseev Andrey A. (orcid.org/0000-0003-1865-8655 Scopus ID: 57191405757).

³ Osterwalder, A. (2004) The Business Model Ontology—A Proposition in a Design Science Approach. Ph.D. Dissertation, University of Lausanne, Lausanne.

- Analysis of General information (Appendix A, E) on companies that objectively reflect the structure of shareholders, investment, financial and operational processes;
- Combined interviews with company representatives. The first wave of the interview is an absentee written questionnaire based on a structured questionnaire (App. B) – “open” questions. The second wave is a face-to-face in-depth interview (personal, telephone, Internet).

The result of information collection is presented in the form of company cards:

- Systematized General information (Indexs – Appendix A, Sampe – App. E);
- Answers to respondents' questions in free form, interpreted by interviewers (Appendix B);
- Description of the case – the completed project, contract (82Q – App. B).

The qualitative analysis of information (stage 2) is based on the study of company cards and cases. Sources of Data on which investigated Building Block of Business Model are presented in table. 3. The analysis is based on the systematization of similar CARO features for each Building Block.

The variability of the contents of a single Building Block determines the CARO types (App. D).

In relation to the types allocated by CARO, Business Models have been developed.

Sources of Data & Collection Process

The University of Turku (UTU) team (CAROTS project partner) has compiled (2019) a list of 140 Europe companies – hypothetical CARO. An initial analysis of the financial parameters of the CARO market, presented by the Report⁴, has been performed.

According to the definition (see Definition of Terms), the following criteria for CARO affiliations are identified:

- SME (Staff headcount < 250; Turnover \leq € 50m or Balance sheet total \leq € 43 m)⁵;
- Private companies and for-profit;
- Intermediary in process of technology transfer (fig. 1);
- Specialization in support, consultation, analytical research and measurement services;
- Activities field (see Definition of Terms): Life Science/BioTech, NanoTech and Clean-Tech.

The initial UTU sample (140) was adjusted according to the CARO criteria. The UNECON team compiled an improved sample of 104 CARO enterprises (Secondary sampling – App. D). This sample was the basis for analysis in the "General information" section.

⁴ CARO Industry Overview. Report. [draft version] Grönlund, Mikko, Laiho, Taina, Ranti, Tuomas, Stenvall-Virtanen, Sari, Head of Education, UTU, 2020

⁵ Report from the commission on the implementation of the commission recommendation (2003/361/ec) of 6 May 2003 concerning the definition of micro, small and medium-sized enterprises.

Table 3. Sources of Data on which investigated Building Block of Business Model.

| Pillar | Building Block of Business Model | Sources of Data (Appendix A, B) |
|---------------------------|----------------------------------|--|
| Product | Value Proposition | 31Q: What services are provided by your company? 32Q: Are you specialized in a research method (e.g. offering a certain lab technology) or rather in a sectoral topic or branch (e.g. focused on the wood or steel industry)? 33Q: What are the specific services you provide to small innovative and industrial enterprises? Basic services and enterprise services. Principle of pricing (price list, if available) |
| Customer Interface | Target Customer | 41Q: What are your main clients? 42Q: Does your CARO mainly operate on a national or international level? Systematization of customers by industry and type of service. |
| | Distribution Channel | 21Q: How would you describe the position of the enterprise in the national innovation system? 22Q: What is your market position? |
| | Relationship | 82Q Would you be willing to describe one of your (prominent) projects to us? A0. Mission (the official mission statement from the company's website or based on the results of the interview) |
| Infrastructure Management | Value Configuration | 52Q: What are the main resources you use in contracting: labs, personnel, third-party contracts? 82Q Would you be willing to describe one of your (prominent) projects to us? |
| | Capability | 71Q: Could you elaborate a bit further on the history of your company: what were the main challenges? 72Q: Could you highlight 1–3 system trends you have observed in your community lately? 83Q Or could you even give us a list with brief descriptions of implemented projects? A4. Industry classification (NACE Rev. 2 main section) A3. Size & group information A10. Number of employees A12. Management & staff A13. Controlling shareholders |
| | Partnership | 82Q Would you be willing to describe one of your (prominent) projects to us? 52Q: What are the main resources you use in contracting: labs, personnel, third-party contracts? 11Q: How was the company set up, who established it and for what purpose? 12Q: Who became the main investor, company's shareholder? A13. Controlling shareholders A4. Industry classification (NACE Rev. 2 main section) |
| Financial Aspects | Cost Structure | A5. Key financials & employees A7. Balance sheet |

| Pillar | Building Block of Business Model | Sources of Data (Appendix A, B) |
|--------|----------------------------------|--|
| | | <p>A8. Assets</p> <p>A9. Liabilities & equity</p> <p>61Q: How do you finance your overhead (eg. advertising, training, methods development, administration, legal consulting) costs and investment into equipment and tangible assets?</p> <p>63Q: If the CARO has reached a break-even point after how many years did that happen? (is it possible to share a year-on-year balance sheet?</p> <p>64Q: Would an injection of additional investment be helpful now after the initial set-up phase and how much? If yes, where would you look to obtain this investment?</p> <p>82Q Would you be willing to describe one of your (prominent) projects to us?</p> |
| | Revenue Model | <p>A11. Profit & loss account</p> <p>A14. Current subsidiaries (funding and grants)</p> <p>62Q: Have you managed to attract funding for innovative projects from public (banks, grants) or private support programs (e.g. self-funding, investors, banks, loans)? If so, how much and if private support was a rate of return agreed.</p> <p>82Q Would you be willing to describe one of your (prominent) projects to us?</p> <p>51Q: Let's have a look at the company's business numbers of the past years. Are you satisfied with the development?</p> |

The UNECON team uploaded information on the hypothetical CARO (UTU list) for the reporting period 2018 from the Amadeus database⁶. Information provided to partners in preparation for the second wave of the survey.

Information collection (2 wave interview) was carried out by the partners of the CAROTS project according to regional localization:

- Deutsches Elektronen-Synchrotron DESY (Germany);
- Helmholtz-Zentrum Geesthacht für Material- und Küstenforschung HZG (Germany);
- University of Turku UTU (Finland);
- Foundation of Innovative Initiatives (Poland);
- Saint Petersburg State University of Economics UNECON (Russia);
- Lithuanian Innovation Centre (Lithuania);
- University of Tartu (Estonia);
- Investment and Development Agency of Latvia (Latvia);
- The Capital Region of Denmark/Region Hovedstaden (Denmark);
- Danish Technological Institute (Denmark).

CAROTS project partners conducted interviews and compiled 27 CARO cards (App. C), which formed the basis of the analysis by the UNECON team reflected in this Report.

⁶ <https://amadeus.bvdinfo.com/>

Analysis of Data

General information

For the sample (App. E), quartiles are generated by revenue level, Table 4. Quartiles explain the evolution of CARO as a company (more in Report⁷).

Table 4. CARO quartiles in the secondary sample (Appendix E).

| Quartiles % | Aggregated Operating revenue (Turnover) th EUR |
|-----------------|--|
| First quartile | 7 |
| Second quartile | 764 |
| Third quartile | 5,862 |
| Fourth quartile | 13,965 |

CARO average financial indicators (Table 5) and structure of the balance sheet (Fig. 2) became the basis for evaluating financial information.

Table 5. CARO average financial indicators in the secondary sample (App. E).

| Indicator | Average |
|--|---------|
| Op. Rev th EUR th EUR | 4414,6 |
| Number of employees | 35,6 |
| P/L for period th EUR | 311,3 |
| Total assets th EUR | 5933,4 |
| Shareholders funds th EUR | 2545,9 |
| Profit margin % | 7,2 |
| ROE using P/L before tax % | 18,4 |
| Fixed assets th EUR | 2986,1 |
| Loans th EUR | 98,6 |
| Creditors th EUR | 270,9 |
| Gross profit th EUR | 5287,9 |
| ROA using P/L before tax % | 8,1 |
| EBITDA Margin % | 13,1 |
| EBIT Margin % | 9,2 |
| Profit per employee th EUR | 18,3 |
| Operating revenue per employee th EUR | 177,1 |
| Costs of employees / Operating revenue % | 41,9 |
| Average cost of employee th EUR | 45,7 |
| Shareholders funds per employee th EUR | 78,6 |
| Working capital per employee th EUR | 22,6 |
| Total assets per employee th EUR | 180,1 |
| Export revenue / Operating revenue % | 48,488 |

⁷ CARO Industry Overview. Report. [draft version] Grönlund, Mikko, Laiho, Taina, Ranti, Tuomas, Stenvall-Virtanen, Sari, Head of Education, UTU, 2020

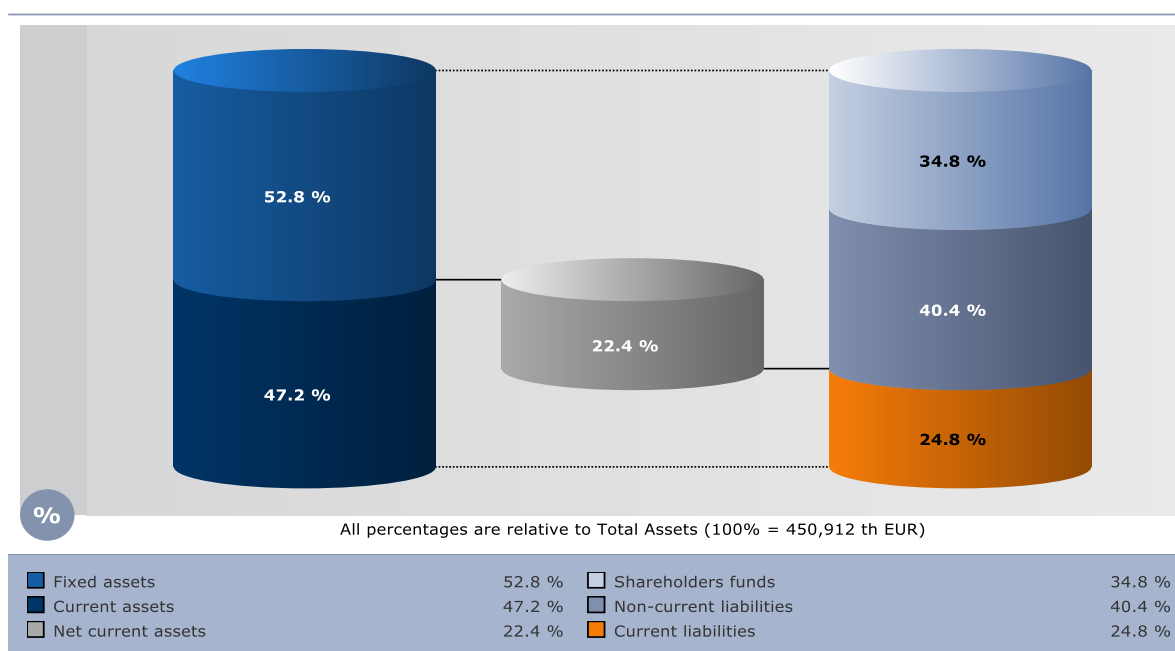


Fig. 2. Structure of the balance sheet (aggregated, App. E).

Key findings from the analysis of statistical indicators of the CARO sample:

- CARO is a financially efficient, sustainable activity (Profit margin 7,2%; EBITDA Margin – 13,1%);
- A significant average value of fixed assets (52.8% aggregated index) is associated with laboratory and experimental equipment, that is, CARO conduct R&D and (or) provide services based on their own assets (Fig. 2);
- CARO also conducts initiative R&D as part of innovative projects, as indicated by the need for financing (Creditors th EUR – 270,9);
- CARO attracted external financing (Fig. 2) – shareholders' funds account for only 34.8% in the balance sheet;
- The main resource (cost) of CARO is personnel (Costs of employees / Operating revenue – 41.9%).

Classification

For sampling (App. E) the CARO classification is presented according to NACE Rev. 2, Table 6. Most CAROs relate to «M. Professional, scientific and technical activities».

Table 6. CARO Identification NACE Rev. 2⁸.

| Industry (NACE Rev. 2) | Share |
|--|-------|
| C. Manufacturing | 4% |
| D. Electricity, gas, steam and air conditioning supply | 1% |

⁸ NACE Rev. 2 – Statistical classification of economic activities in the European Community. Luxembourg: Office for Official Publications of the European Communities 2008 — 363 pp.

| Industry (NACE Rev. 2) | Share |
|---|------------|
| F. Construction | 3% |
| G. Wholesale and retail trade; repair of motor vehicles and motorcycles | 4% |
| J. Information and communication | 3% |
| K. Financial and insurance activities | 2% |
| M. Professional, scientific and technical activities | 73% |
| most often: | |
| M71.2 – Technical testing and analysis | |
| M72 – Scientific research and development | |
| M72.1 – Research and experimental development on natural sciences and engineering | |
| M72.1.1 – Research and experimental development on biotechnology | |
| M72.1.9 – Other research and experimental development on natural sciences and engineering | |
| N. Administrative and support service activities | 4% |
| O. Public administration and defence; compulsory social security | 2% |
| Q. Human health and social work activities | 4% |
| S. Other service activities | 5% |
| All | 100% |

In the process of analysis, 3 CARO types are highlighted (full list App. D):

1. "R&D": invest in laboratory equipment, perform custom and initiative (own) research. The latter are positioned as their own innovative projects. The core competency – R&D;
2. "Service": provide engineering services (modeling, prototyping, engineering, measurements, testing, access to RI etc.) for start-ups that implement innovative projects. Own innovation projects do not initiate. The core competency is a professional engineering service;
3. "Consulting": provide innovative management services (management of innovative projects, search for financing, consulting, marketing research, business planning etc.) for start-ups that implement innovative projects. They can implement their own innovative projects, join a consortium with start-ups, etc. The core competency is innovative entrepreneurship.

Value Proposition

"R&D" и "Service" CARO Value Proposition: "Niche" specialized R&D & service.

CARO offers "niche" specialized R&D & services, adding value to innovative counterparty projects. Their R&D and labs equipment are highly specialized. Industrial enterprises do not create specialized labs and do not employ fulltime researchers on narrow problems due to the insignificant load. This "niche" is occupied by CARO (type "R&D" and "Service"). In innovative projects, they act as sub-contractors and (or) consultants. Initiation of our own innovative projects is due to the need to obtain grants that ensure the sustainability of cash flow, overheads coverage.

«Consulting» CARO Value Proposition: Reducing the «transaction costs» of the innovation process.

CARO is focused on start-ups and researchers. They provide contractual assistance at all stages of the innovation project (Pre-Seed, Seed, Series A-D). CARO service consists in organizing an innovative project, fundraising, marketing and searching for contractors. Their competence is "innovative entrepreneurship", which is expressed in the presence of knowledge and experience in organizing innovative projects. They are familiar with RI, financial institutions, and they know well government support programs. The result of their activity is to reduce the duration of the startup cycle (stages) for the search for marketing and financial resources ("transaction costs"), that is, overcoming the "Death Valley".

CARO Value Proposition (**in the whole**): formation of added value in innovative projects due to R&D, services and acceleration of stages.

CARO business model shows its uniqueness, having «Value Proposition» that distance it from previously known institutes of technological transfer («innovative consulting», «intellectual broker», «R&D commercialization center», etc.):

1. R&D (the presence of LABs), the formation of scientific competencies;
2. Creation of added value in innovative projects;
3. Belonging to a specific scientific, innovative eco-system.

CARO's market position is realized through a service offer, Table 7.

Table 7. A complete list of CARO specific services.

| Service | Content |
|--|---|
| Project Management | Project management services of technological innovation. |
| R&D | R&D service provision for innovative products and processes. |
| Process audit | Current and prospective need assessment in technologies and equipment of primary and secondary business processes. |
| Prospective development plan formation | Strategic research plan and development works in accordance with global scientific and technical perspectives of the industrial (technological platform) development. |
| Knowledge and technology effect assessment | Potential effect assessment of knowledge and technology attraction into primary and secondary production processes, research and development program inclusion. |
| Terms of Reference (ToR) development | Terms of Reference development for technologies, R&D and engineering services. |
| Innovative infrastructure access | Accessing to the innovative infrastructure (technoparks, multiple-access centers, etc.). |
| Prototyping | ToR preparation service and prototyping process tracking as well as modelling and field testing of innovative products. |
| Certification | Certification process tracking (within national and international requirements) of products and processes. |
| Engineering services | Engineering services provision (direct or intermediary) within technology innovation processes. |
| Expert services | Expert services provision (direct or intermediary) within technology innovation processes. |
| Legal expertise | Legal innovation expertise, as well as intellectual property asset management. |

| Service | Content |
|------------------------------------|--|
| Patenting (application, process) | Application preparation and patenting process tracking in national and international bureaus. |
| Funding | Engaging business angels, investors, funds and government financing (including all types of resources) at all stages of the innovation cycle. |
| Raising venture funds | Venture capital attraction into an innovative project. |
| Technology transfer | Technology and knowledge recipients' search, intermediary in their commercialization. |
| Marketing services | Market research services for innovative products, participation in the negotiation process. |
| Business planning | Business planning, technical and economic assesment and investment planning of technological innovation services. |
| Business Process Engineering (BPE) | Business Process Engineering services related to the implementation of innovative processes and products. |
| Access to distribution chanel | Development of the innovative product marketing system, participation in the negotiation process with potential customers, distribution inter-mediaries. |

Target Customer

There are 2 types of CARO strategic clients: "Researchers, startups" (1) and "Industry" (1). This is what CARO's intermedial position in the innovation process consists of: linking researchers, startups and industry.

Researchers, startups need CARO «Consulting» services to overcome the "Death Valley" and CARO «Service» services to carry out specialized research, tests and measurements. Industry turns to CARO "Service" and "R&D" to perform specialized research and / or tests. In the CARO Value Proposition ("Niche" specialized R&D & service), global industrial market leaders turn to their services.

Distribution Channel

Initially, CARO form a portfolio of projects from anchor, large clients (global market leaders) creating a goodwill. In a number of cases, CARO was founded to implement R&D for a large client or project.

Secondarily, CAROs scale based on networking. Surveyed CAROs use various marketing tools but converge in the vision of "networking" (sci, prof, etc) as the most effective and promising. Networks Positions Specialized CARO Services in the Innovation Ecosystem.

Relationship

CARO configures the service and R&D areas in cooperation with strategic clients (global market leaders) and their needs. They monitor the activities of customers, their innovative prospects (in which they see participation). Thus, CARO belonging to the innovation ecosystem, the core of which is their strategic customers (global market leaders).

Value Configuration

Value creation of the CARO business proposal (type “R&D” and “Service”) is based on investing in resources: Labs & Researches. This type of CARO is interested in investing in labs and grants, which they cover the costs of fulltime researches.

Value creation of a CARO business proposal (type “Consulting”) is built on their fundraising opportunities attractive to startup & researchers. CARO is well aware of venture and public funding programs, the application process and has “personal” contacts in public and private funds.

Capability

Sustainability, quality of CARO services (type “R&D” and “Service”) is based on investing in labs and involving fulltime researchers. In some cases, an alternative is to obtain exclusive access to university (industrial) labs and (or) scientific groups.

Sustainability, quality of CARO services (type “Consulting”) is determined by continuous monitoring of relevant information on grants and programs of scientific, innovative development. Experience and reputation (successful innovative projects) CARO is also in some cases the basis of capability.

Partnership

Partnership is an important part of CARO's strategic position.

CARO type “R&D” builds partnerships with universities, large industrial enterprises (industry leaders), clusters and state structures.

CARO type “Service” builds partnerships with scientific and industry networks, whose lab profile can expand their service.

CARO type “Consulting” builds partnership with state structures, innovative and scientific grant funds.

Cost Structure

CARO revenues are not evenly distributed in the operating period. Accordingly, the main problem of all types of CARO in covering overheads, creating financial instability. Credit policy availability also indicates this (Table 5).

According to Analysis of Operating Finances (App. A), CARO expenses (R&D and Service types) focus on fixed assets (labs equipment). They claim the demand for investment in the labs.

Costs CARO type "Consulting" focused on staff and marketing. Investments are not in demand.

Table 8. Cost structure CARO (statistic App. A, sample case study App. E, Table 5).

| CARO type | Cost Structure, % | | | | |
|------------|-------------------|-----------|--------------------------|-------------|-------------------|
| | Staff | Equipment | Materials and components | Contractors | Sales & Marketing |
| R&D | 40 | 40 | 15 | 10 | 5 |
| Service | 20 | 40 | 25 | 10 | 5 |
| Consulting | 40 | | | 20 | 40 |

Revenue Model

Analysis of the cases of implemented CARO projects (App. E) allowed us to distinguish 3 main types of income (Table 9), formed on the basis of services (Table 7).

Table 9. Types of Income in CARO Contracts.

| Income generation concept | Nature of contractual relations | Average (sample), % |
|---------------------------|---|---------------------|
| Management fee | Absolute (fixed cost) or equity (proportional to the financial indicators of the innovation project) payment of the CARO services recipient on the results of the commercial contract implementation. | 20 |
| R&D and other services | Income from performed services (measurements, engineering, etc.) is directly received by the employees of the company. | 65 |
| Grants | Grants and Funds Income | 15 |

CARO type “R&D” is based on revenue from R&D payment and grants, often combining these sources in a single innovative project.

CARO type “Service” is almost 100% based on revenue from service payment.

CARO type “Consulting” is the main income management fee for managing innovative projects. When attracting external financing, income is generated from agent fees.

Grants are an important part of maintaining the financial sustainability of all types of CARO. To do this, they generate their own innovative projects, initiative R&D, less often fundamental research program.

Summary

Problem. Bridging the «Death Valley», «Innovation Gap» remains as a problem in the development of markets, primarily in the high-tech sector.

Purpose: Highlight an effective CARO business model, which could be addressed to organizations of this type to improve their competitive position.

Summary:

Thesis 1: CARO was formed as a promising institute of technological transfer, increasing the effectiveness of the conversion of R&D results to commercial innovations.

Thesis 2: There are 3 types of CARO. CARO business model has common building blocks, some of which are variable in types of CARO.

Table 10. The results of the study of CARO's business models for the selected types.

| Pillar | Building Block of Business Model | CARO Type | | |
|---------------------------|----------------------------------|---------------------------------------|-----------------------|--|
| | | R&D | Service | Consulting |
| Product | Value Proposition | "Niche" specialized R&D & service | | Reducing the «transaction costs» of the innovation process |
| Customer Interface | Target Customer | | Researchers, startups | |
| | | Industry | | |
| | Distribution Channel | Networking (sci, prof, etc) | | |
| | Relationship | Belonging to the innovation ecosystem | | |
| Infrastructure Management | Value Configuration | Labs & Researches | | Fundraising opportunities |
| | Capability | Own Labs & Researches | | Staff |
| | Partnership | University / Industry / Gov | Sci networks | Innovative and scientific grant funds |
| Financial Aspects | Cost Structure | Fixed assets (labs equipment) | | Staff & marketing |
| | Revenue Model | R&D payment / grants | Service payment | Management fee |

Thesis 3: CARO business model shows its uniqueness, having properties (building blocks) that distance it from previously known institutes of technological transfer («innovative consulting», «intellectual broker», «R&D commercialization center», etc.):

1. R&D (the presence of LABs), the formation of scientific competencies;
2. Creation of added value in innovative projects;
3. Belonging to a specific scientific, innovative eco-system.

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Appendix

A. General information (derived from homepages and databases Amadeus)

- A0. Mission (the official mission statement from the company's website or based on the results of the interview)
- A1. Contact details
- A2. Legal & account information
- A3. Size & group information
- A4. Industry classification (NACE Rev. 2 main section)
- A5. Key financials & employees
- A6. Global standard format
- A7. Balance sheet
- A8. Assets
- A9. Liabilities & equity
- A10. Number of employees
- A11. Profit & loss account
- A12. Management & staff
- A13. Controlling shareholders
- A14. Current subsidiaries (funding and grants)

B. Interview questions for intermediate companies (CAROs)

- 1. CARO's founding phase
 - 11Q: How was the company set up, who established it and for what purpose?
 - 12Q: Who became the main investor, company's shareholder?
- 2. CARO functions
 - 21Q: How would you describe the position of the enterprise in the national innovation system?
 - 22Q: What is your market position?
- 3. CARO services
 - 31Q: What services are provided by your company?
 - 32Q: Are you specialized in a research method (e.g. offering a certain lab technology) or rather in a sectoral topic or branch (e.g. focused on the wood or steel industry)?
 - 33Q: What are the specific services you provide to small innovative and industrial enterprises? Basic services and enterprise services. Principle of pricing (price list, if available)
- 4. CARO market
 - 41Q: What are your main clients?
 - 42Q: Does your CARO mainly operate on a national or international level?

Systematization of customers by industry and type of service.
- 5. CARO economy
 - 51Q: Let's have a look at the company's business numbers of the past years. Are you satisfied with the development?
 - 52Q: What are the main resources you use in contracting: labs, personnel, third-party contracts?

6. CARO resources

61Q: How do you finance your overhead (eg. advertising, training, methods development, administration, legal consulting) costs and investment into equipment and tangible assets?

62Q: Have you managed to attract funding for innovative projects from public (banks, grants) or private support programs (e.g. self-funding, investors, banks, loans)? If so, how much and if private support was a rate of return agreed.

63Q: If the CARO has reached a break-even point after how many years did that happen? (is it possible to share a year-on-year balance sheet?)

64Q: Would an injection of additional investment be helpful now after the initial set-up phase and how much? If yes, where would you look to obtain this investment?

67Q: Would you have a suggestion to policy makers and public authorities on how to support a company like yours better?

68Q: Could we contact your financiers to evaluate their motivations and needs in funding a CARO?

7. CARO challenges & trends

71Q: Could you elaborate a bit further on the history of your company: what were the main challenges?

72Q: Could you highlight 1–3 system trends you have observed in your community lately?

8. CARO CASE

82Q Would you be willing to describe one of your (prominent) projects to us?

83Q Or could you even give us a list with brief descriptions of implemented projects?

C. List of CARO (interview sample)

| Company name | Country | Case | Specializa- tion | Field |
|--|---------|-----------|----------------------|---|
| Measur Oy | Finland | n/a | Measure- ments | Multidisciplinary |
| Strategic Scientific Consult- ing Oy | Finland | n/a | Consulting | Circular economy, phar- maceuticals, diagnostics |
| Zerust Oy | Finland | n/a | Marketing & Sales | Engineering |
| CEST | Austria | n/a | R&D | BioTech (Electrochemis- try_ |
| MATECC AS | Estonia | n/a | R&D | NanoTech |
| ADAPTER | Estonia | Disclosed | Consulting | Multidisciplinary |
| TFTAK | Estonia | Disclosed | R&D | BioTech (Fermentation) |
| Eurofins Environment Test- ing Estonia OÜ | Estonia | Disclosed | Labs Testing | BioTech |
| IMECC | Estonia | n/a | R&D | Engineering (IT) |
| DTI | Denmark | n/a | R&D | Multidisciplinary (X-ray, neutron analyses) |
| LINX | Denmark | n/a | R&D | Multidisciplinary (X-ray, neutron analyses) |
| SOLID-CHEM GmbH | Germany | n/a | R&D | BioTech (solid-state chemistry) |

| Company name | Country | Case | Specializa- tion | Field |
|---|-------------|-----------|--|---------------------------------|
| FEAC Engineering | Greece | n/a | Engineering (diigital sim- ulation) | Multidisciplinary |
| Celignis | Ireland | n/a | R&D | BioTech (biomass analy- sis) |
| Baltic Institute of Advanced Technology | Lithuania | Disclosed | R&D | Multidisciplinary |
| Altechna R&D | Lithuania | Disclosed | R&D | Engineering (Photonics) |
| Polytech-consult Ltd | Russia | Disclosed | R&D | CleanTech (Engineering) |
| CTT EEBl | Russia | Disclosed | R&D | NanoTech (Cryogenic) |
| Polymer Institute ltd | Russia | Disclosed | R&D | NanoTech (Polymers) |
| Rinno | Russia | Disclosed | Consulting | BioTech, NanoTech |
| Excelsus Structural Solu- tions (Swiss) AG | Switzerland | n/a | R&D | BioTech |
| Lidaris Ltd. | Lithuania | Disclosed | R&D, Labs Testing | Engineering (Photonics) |
| Muovipoli Oy | Finland | n/a | R&D, Labs Testing | NanoTech (Polymers) |
| Puska consulting | Finland | n/a | R&D, Labs Testing | NanoTech (Polymers) |
| GLOKOR | Poland | n/a | Consulting | Multidisciplinary |
| Materize | Latvia | n/a | R&D | NanoTech (Photonics) |
| CR competence | Sweden | n/a | Consulting | BioTech |

D. CAROs classification by type

| Compane name | CARO type | | |
|---|-----------|---------|------------|
| | R&D | Service | Consulting |
| Measur Oy | | | |
| Strategic Scientific Consulting Oy | | | |
| Zerust Oy | | | |
| CEST | | | |
| MATECC AS | | | |
| ADAPTER | | | |
| TFTAK | | | |
| Eurofins Environment Testing Estonia OÜ | | | |
| DTI | | | |
| LINX | | | |
| SOLID-CHEM GmbH | | | |
| FEAC Engineering | | | |
| Celignis | | | |
| Baltic Institute of Advanced Technology | | | |
| Altechna R&D | | | |
| Polytech-consult Ltd | | | |
| CTT EEBl | | | |

| Company name | CARO type | | |
|--|-----------|---------|------------|
| | R&D | Service | Consulting |
| Polymer Institute Ltd | | | |
| Rinno | | | |
| IMECC | | | |
| Excelsus Structural Solutions (Swiss) AG | | | |
| Lidaris Ltd. | | | |
| Muovipoli Oy | | | |
| Puska consulting | | | |
| GLOKOR | | | |
| Materize | | | |
| CR competence | n/a | | |

E. Secondary sampling (104 Amdeus DB)

| Company Name | Country | NACE |
|--|---------|------|
| Institutul National De Cercetare-Dezvoltare Pentru Fizica Materialelor | RO | 7219 |
| Hr Wallingford Limited | GB | 7219 |
| Offshore Renewable Energy Catapult | GB | 7490 |
| Aimplas Asociacion De Investigacion De Materiales Plasticos Y Conexas | ES | 7219 |
| Institut Fuer Luft- Und Kaelte-technik Gemeinnuetzige Gesellschaft Mbh | DE | 7219 |
| Galab Laboratories Gmbh | DE | 7120 |
| Synpo, A.S. | CZ | 7219 |
| Eurotrials – Consultores Cientificos, Unipessoal, Lda | PT | 7219 |
| Nizo Food Research B.V. | NL | 7219 |
| Syncom B.V. | NL | 7219 |
| Proteros Biostructures Gmbh | DE | 7211 |
| Organic Waste Systems | BE | 3511 |
| Vironova Ab (Publ) | SE | 6201 |
| Rlp Agrosience Gmbh | DE | 7219 |
| Xray-Lab Gmbh & Co. Kg | DE | 8200 |
| Verhaert Newproducts & Services | BE | 7022 |
| Emas Pharma Limited | GB | 8690 |
| Vyzkumny Ustav Stavebnich Hmot, A.S. | CZ | 7219 |
| Cest Kompetenzzentrum Fuer Elektrochemische Oberflaechentechnologie Gmbh | AT | 7200 |
| Eit Rawmaterials Gmbh | DE | 7219 |
| Glatec, Technologiezentrum An der Empa In Dubendorf | CH | 9499 |
| Dr. Peter Sommer Werkstofftechnik Gmbh | DE | 7112 |
| Ras Ag | DE | 7210 |
| Research Institute for Chromatography | BE | 7112 |
| Centrum Innowacji Stb Sp. Z O.O. Sp.K. | PL | 6499 |
| Uab Altechna R&D | LT | 7219 |
| Inovapotek, Pharmaceutical Research and Development, Lda | PT | 7219 |
| Ebrc Consulting Gmbh Fuer Umweltwissenschaftliche Dienstleistungen | DE | 7022 |
| Pion Inc. (Uk) Ltd | GB | 4669 |
| Eliko Tehnoloogia Arenduskeskus Ou | EE | 7219 |
| Imecc Ou | EE | 7219 |

| Company Name | Country | NACE |
|--|---------|------|
| Agrochemex Ltd | GB | 7120 |
| Mof Technologies Limited | GB | 2059 |
| Surflay Nanotec Gmbh | DE | 7219 |
| Polymerexpert Sa | FR | 7112 |
| Institut Fuer Kunststofftechnologie Und –Recycling (Iktr) E.V. | DE | 7211 |
| Drochaid Research Services Limited | GB | 7490 |
| Uab Lidaris | LT | 7120 |
| Micronit Gmbh | DE | 4618 |
| Innovative Mechanical Engineering Technologies B.V. | NL | 7112 |
| Mi-Partners B.V. | NL | 7219 |
| Monofil Srl | RO | 2016 |
| Rawwater Engineering Company Limited | GB | 7490 |
| Delta Engineering & Chemistry Gmbh | DE | 7210 |
| Veqter Ltd | GB | 7120 |
| Smerud Medical Research International As | NO | 8690 |
| Cr Competence Ab | SE | 7219 |
| Swansea Materials Research & Testing Ltd | GB | 7219 |
| Microdimensions Gmbh | DE | 4741 |
| Solid-Chem Gmbh | DE | 7120 |
| Cbr 74 Sp. Z O.O. Sp.K. | PL | 4120 |
| Ramo Pro Oy | FI | 7490 |
| Makery Oy | FI | 7490 |
| Crb Analyse Service Gmbh | DE | 7120 |
| Nanocraft Coating Gmbh | DE | 2221 |
| Zerust Oy | FI | 2059 |
| Muovipoli Oy | FI | 6499 |
| Solvo Gmbh | DE | 7219 |
| Inphotech Sp. Z O.O. | PL | 7219 |
| Geomed Impex 2002 Srl | RO | 7112 |
| Adroit Science Ab | SE | 7219 |
| Microbion S.R.L. | IT | 7211 |
| Elastopoli Oy | FI | 7219 |
| Novox Oy | PL | |
| Solve Research and Consultancy Ab | SE | 7112 |
| Excelsus Structural Solutions (Swiss) Ag | CH | 7490 |
| Exposervice Gmbh | DE | 8230 |
| Chipro Gmbh | DE | 7210 |
| Foreningen Linx | DK | 7219 |
| Dancert A/S | DK | 7490 |
| Mated S.R.L. | IT | 7120 |
| Alphamax Partners Limited | IE | 4754 |
| Simgeo, S.R.O. | PL | |
| Amrc Management Limited | GB | 7490 |
| Aquamarijn Micro Filtration B.V. | NL | 7112 |
| Molox Gmbh | DE | 9609 |
| Zeta Partikelanalytik Gmbh | DE | 7210 |
| Genome Enterprise Limited | GB | 7490 |
| Maaratieto Oy | FI | 7022 |

| Company Name | Country | NACE |
|--|---------|------|
| Bioras Aps | DK | 6202 |
| Expose Gmbh | CH | 7490 |
| Instytut Badan I Rozwoju Motoryzacji Bosmal Sp. Z O.O. | PL | 7219 |
| Flashlab | FR | 7120 |
| Pro Novum Sp. Z O.O. | PL | 8211 |
| Centrum Badawczo-Rozwojowe Glokor Sp. Z O.O. | PL | 7219 |
| Fluidlab Oy | FI | 7120 |
| Aquifer, S.R.O. | SK | 7112 |
| Tuv Sud (Uk) Limited | GB | |
| Oy Separation Research Ab | FI | 7120 |
| Ruska Consulting Oy | FI | 7022 |
| Feac Engineering Private Company | GR | 7022 |
| Measur Oy | FI | |
| Strategic Scientific Consulting Finland Oy | FI | 7022 |
| Stichting Kankerfonds Sura | NL | 9499 |
| Zo Os Echo Pri Polymer Institute Brno, Spol.S R.O. | CZ | 9420 |
| Adapter Ou | EE | 4120 |
| Vahanen Oy | FI | 7112 |
| Celignis Limited | IE | 7219 |
| Chembiotech Limited | GB | 7490 |
| Ellis Developments Limited | GB | 7219 |
| F&E Technologiebroker Bremen Gmbh | DE | 8299 |
| Gimopharm | FR | 7120 |
| Novitom | FR | 7120 |
| R B E Limited | GB | 4321 |