



Häme University of Applied Sciences

**MAPPING THE INVESTMENT POTENTIAL IN INDUSTRIAL
SYMBIOSIS**

–ANALYSIS OF SURVEY DATA AND SWOT ANALYSIS

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1 Introduction

This paper was prepared by Häme University of Applied Sciences (HAMK) within the context of the SYMBI project and, more precisely, activity A1.2. It outlines the results of a survey conducted in SYMBI partnership regions, about the willingness to invest in industrial symbiosis. The analysis is based on data collected by the SYMBI partners from the partnership countries, i.e. Poland, Italy, Greece, Spain, Finland, Hungary and Slovenia.

The paper starts with briefly presenting the SYMBI project and then continues explaining the key information about the research process such as data collection, analysis principles and research questions. Next, the result of the survey are presented and analysed by utilizing open coding and SWOT analysis. The objective of the SWOT analysis is to identify the strengths, weaknesses, opportunities and threats related to the investment potential in industrial symbiosis. Two type of SWOT analysis are used. A basic four-quadrant SWOT matrix is used when laying out and analysing the partner-specific results of the survey. A more advanced eight-fold SWOT matrix is then used to combine and analyse the survey results from all partners and to unravel the actions to be made based on the results of the analysis.

The SYMBI project operates with the aim to contribute working towards circular economy and industrial symbiosis. Circular economy is based on the sustainable use of resources by monitoring, minimising and eliminating waste flows by circulating them in the economy. Our current economy is mostly based on a linear production model where products and goods are utilized on a “take-make-dispose” principle. On the linear model products and production are based only on the initial use of the good and recycling is segregated from production. In circular economy, the products and the production are already designed to be reusable, recyclable with minimum waste throughout the whole life cycle.

Industrial symbiosis is a flow of unutilized resource from an entity, which would otherwise discard them, to another entity, which uses them as a substitute for their output. Industrial

symbiosis differs from “normal” transaction between companies or organizations, where goods are sold for the purpose for which they were intended as in industrial symbiosis the good is usually waste, residual or by-products of one entity. Both companies receive extra additional value from a resource that might otherwise be disposed or cause expenses. Industrial symbiosis focuses on the interaction between environment, economy and industry, and promotes the sharing of materials to minimize waste. The idea of industrial symbiosis derives from the example of a natural ecosystem, where materials flow, everything is reused and no waste is produced. Industrial symbiosis contributes towards circular economy, as it is one of the main ways of “closing the loop”.

2 SYMBI Project

SYMBI (Industrial Symbiosis for Regional Sustainable Growth and a Resource Efficient Circular Economy) project is an international EU project focused on improving industrial symbiosis for a resource efficient economy. The aim of the project is to contribute to improve the implementation of regional development policies and programmes related to the promotion and dissemination of Industrial Symbiosis and Circular Economy. The seven participating countries are faced to policies alignment with the Circular Economy strategy of the European Commission to transform Europe into a more competitive resource-efficient economy. The general objective of SYMBI project is to empower regions to build sustainable economies, resilient to environmental pressures and climate change. The project focuses on material industrial symbiosis therefore service related symbiosis are excluded from examinations.

The project is funded by Interreg Europe program. Interreg Europe funds interregional cooperation projects in the field of research and innovation, SME competitiveness, low-carbon economy and environmental and resource efficiency, SYMBI is part of the latter. The general objective of Interreg Europe programs is to promote the exchange of experience and good practices among European Union countries.

The SYMBI consortium consists of nine partners from seven EU countries: Spain, Italy Greece, Slovenia, Hungary, Poland and Finland (Table 1). The partners differ from each other in size and as organizations. Most of the partner organisations are public body organisations operating regionally in their countries. The most vastly operating organisation comes from Slovenia, as the Slovenian partner is a nationally operating governmental body. The smallest partner organisation is the Greek partner whose operation area is regional in the city of Kozani.

Table 1. Introduction of the SYMBI partners

Partner	Abbreviation	Country	Local/ Regional/ National	Role in the project
Foundation FUNDECYT Scientific and Technological Park of Extremadura	FUNDECYT	Spain	Regional	Lead Partner
Environment and Territory Regional Ministry	Andalusia	Spain	Regional	Partner
The Malopolska Region	Malopolska	Poland	Regional	Partner
Chamber of Commerce of Molise	CoC - Molise	Italy	Regional	Partner
Government Office for Development and European Cohesion Policy	SVRK	Slovenia	National	Partner
Municipality of Kozani, Development and Planning Bureau	Kozani	Greece	Local	Partner
Pannon Novum West-Transdanubian Regional Innovation Non-Profit Ltd	PA-NOV	Hungary	Regional	Partner
Regional Council of Häme	HAME	Finland	Regional	Partner
Häme University of Applied Sciences Ltd	HAMK	Finland	Regional	Advisory partner

3 ACTIVITY A1.2 Mapping the investment potential in industrial symbiosis

The aim of the activity A1.2 "Mapping the investment potential in industrial symbiosis" is to find out the willingness and capacity of relevant stakeholders to make investments in developing industrial symbiosis in partners' regions and analyse the investment capacity. The activity was conducted by a survey and it composes of four phases:

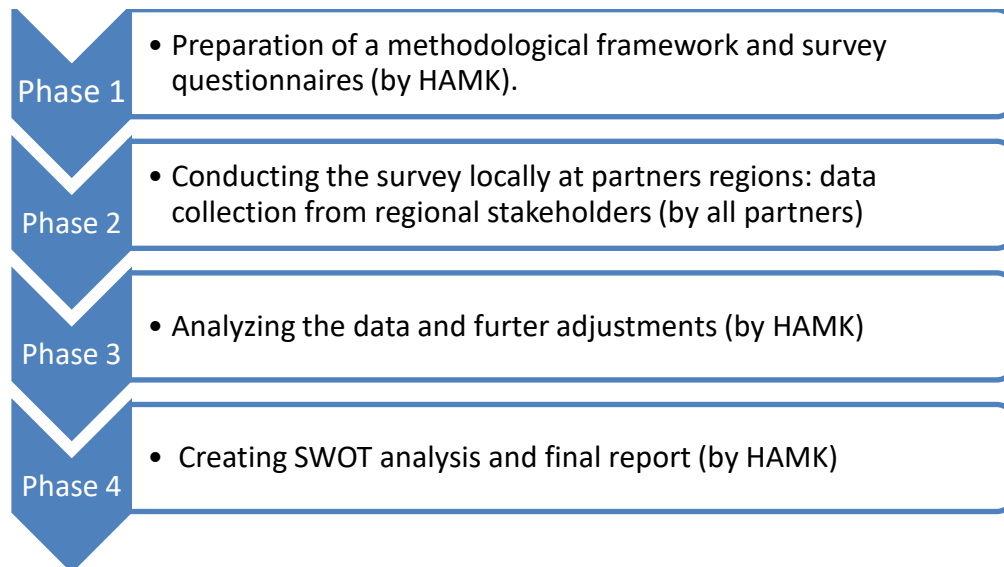


Figure 1. The Four phases of the activity A1.2

The first phase was the preparation of a methodological framework of the activity. The survey was conducted in the second phase of the activity. The aim of the survey was to map the willingness and capability to invest in industrial symbiosis among relevant stakeholders. The survey was done in three different versions: one for companies, one for public sector administration and one for banks and investors. The target number of answers in the three categories were:

- companies 10,
- public sector administrations 2,
- banks and investors 5.

The questionnaire consist of open-ended questions targeting the ability to allot financial support to industrial symbiosis projects and possible involvement in such projects. Based on the results of the survey a SWOT analysis was made to compose the findings. The third and the fourth phase (Figure 1.) focus on the analyzation of the survey data and creation of the SWOT analysis. The objective of the SWOT analysis is to narrow down the scope of policies related to unlocking investments in industrial symbiosis and to identify new opportunities and areas to which not to proceed.

3.1 Research questions

The aim with the original format of the questionnaires was to design them to be short and simple for getting as good coverage as possible. The partners had the change to modify the survey questionnaires, as they preferred. The modified questionnaires can be found as appendix. Most of the partners used the original format of research questions but especially the Slovenian partner modified the questionnaire with extra questions.

QUESTIONNAIRE FOR COMPANIES

1. Basic information

- * Name of respondent
- * Company or organization
- * Country and region

Revenue

Number of staff

*compulsory questions

Are you already involved in industrial symbiosis? Answer question 2 or 3.

2. YES, we are already involved in industrial symbiosis

- How big were the investments and what were the estimated payback times for the investments? (Please describe as many cases as you feel appropriate)
- What is this symbiosis all about: giving/receiving materials, utilizing/sharing other resources?
- What kinds of objectives, obstacles or drivers are involved in industrial symbiosis according your experience?

3. NO, We are not already involved in industrial symbiosis

- Would you think industrial symbiosis could be beneficial for your company?
 - Could it be giving/receiving materials, utilizing/sharing other resources? If possible, explain what are these materials or resources.
 - Would you be willing to invest in industrial symbiosis, how much (€ and/or % of revenue)? What would be the expected time for payback?

QUESTIONNAIRE FOR MUNICIPALITIES AND CITIES, REGIONAL BUSINESS DEVELOPMENT AGENCIES, REGIONAL ADMINISTRATION AND COUNCILS, NATIONAL ADMINISTRATION AND MINISTRIES, NATIONAL INNOVATION AGENCIES

1. Basic information

Name of respondent

Company or organization

Country and region

Operational level

- municipal
- regional
- national

2. Are you able to allot financial support for companies in creating industrial symbiosis? Do you have a budget for supporting circular economy and/or industrial symbiosis investments? What is the budget per year and what are the conditions supporting your decision to invest? If the budget is not fixed, please explain.

3. Do you have other way of supporting companies in their activities among circular economy and/or industrial symbiosis investments?

Please explain.

QUESTIONNAIRE FOR INVESTORS AND BANKS

1. Basic information

Name of respondent

Company or organization

Country and region

2. Are you willing to invest in industrial symbiosis or circular economy in general? Do you have instruments for supporting circular economy and/or industrial symbiosis investments?

- What are these instruments and what are the conditions supporting your decision to invest?

3.2 Data analysis methods

The survey data was analysed through open coding and SWOT analysis. Open coding is a commonly used method when analysing qualitative survey data. SWOT analysis was chosen because it's pervasive nature. SWOT analyses are common to Interreg projects, as a useful starting point to steer the development and/or implementation of policies at territorial level. The SWOT analysis is anticipated to highlight the areas on which public authorities should focus, by taking into account both enabling and inhibiting factors, at internal and external level (e.g. strong public administration staff capacity vs. limited funding possibilities, innovative business culture vs. abundance of raw materials, etc.). Overall, making industrial symbiosis happen, especially in areas lagging behind, requires careful planning and realistic estimations; to this end, the SWOT analysis is expected to assist in the definition of directions and boundaries, based on the territorial potential identified through this research.

3.2.1 Open coding

Open coding is a method to analyse qualitative data as a stage-by-stage process. In open coding the data is read through several times to break the information into pieces in order to examine closely and compare relations, similarities and dissimilarities. After reading the data several times the aim is to find tentative labels for chunks of data that summarize key findings. Open coding is not guided by the researchers' theoretical assumptions, but by the data itself. The results should not be based on existing theory but instead on just the findings that emerges from the data. The main aspects of open coding are:

- Identify the underlying issue and phenomenon.
- Identify the actors involved and the roles they play.
- Identify the reasons attached to the phenomenon.
- Identify strategies to achieve the goal.

3.2.2 SWOT analysis

SWOT analysis is a strategic management tool. The term SWOT is an abbreviation of the words Strengths, Weaknesses, Opportunities and Threats. The analysis consists on evaluating these four factors. SWOT analysis is usually presented on a four-fold matrix (Figure 2). The four quadrants of a SWOT analysis grid are divided to internal and external factors. Strength and weakness are internal factors, as they already exist in the matter that is analysed. Strengths and weaknesses address the matters that enable or prohibit performing as well as possible. Opportunities and threats are external factors as they stem and span outside of the matter that is analysed, and are therefore environmental factors. External factors are for example current and future trends, markets and political, economic and environmental issues.

By listing favourable and unfavourable internal and external issues in the four quadrants of a SWOT analysis grid, planners can better understand how strengths can be leveraged to realize new opportunities and understand how weaknesses can slow progress or magnify organizational threats. SWOT analysis is widely used in planning purposes due to its simplicity and pervasive nature. The key in SWOT analysis is to be able to address complex strategic situations by reducing the quantity of information to improve decision-making.

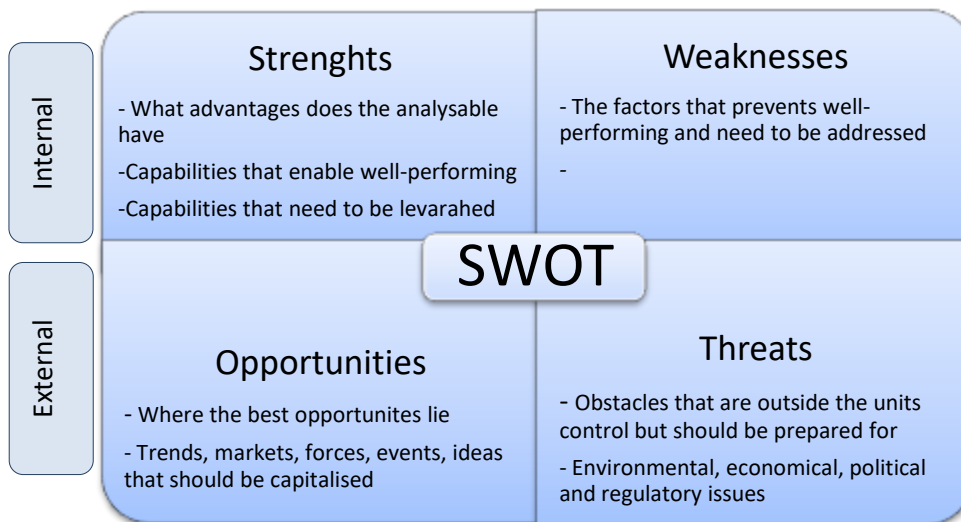


Figure 2. The four quadrants of a SWOT analysis

4 The survey results

The distribution of the survey was selected by each SYMBI partner with the aim to achieve the target number of answers. All of the partners distributes the survey via email or as an online survey. Table 2 entails the survey results from each partner in the three stakeholder groups. The “sent” column covers the number of sent surveys to the specific stakeholders. The “replies” column covers the replies received and the “analysable” column covers the number of which received answers entitled enough information in order to be analysed. Some of the replies were unsuitable to be analysed because they did not entail enough information such as basic information of the company (name of the organisation) or most (90 % or over) of the questions were left unanswered. SYMBI project focuses on material industrial symbiosis so in case the reply represented industrial symbiosis situation from service sector, the answer was unanalysed.

Table 2. Survey results by partners in the three categories

Partner	Companies			Public sector			Investors and Banks		
	Sent	Replies	Analysable	Sent	Replies	Analysable	Sent	Replies	Analysable
FUNDECYT (ES)	250	8	7	5	3	3	10	3	2
Andalusia (ES)	15	4	4	8	1	1	0	0	0
Malopolska Region (PL)	16	3	3	9	1	1	1	0	0
Molise (IT)	-	-	13	-	-	4	-	-	2
SVRK (SL)	2000	388	121	250	141	35	13*	31	2
Kozani (GR)	2	1	1	5	5	5	1	0	0
Pannon Novum (HU)	-	9	-	-	5	-	-	2	-
HAMK (FI)	3067	77	76	19	6	6	18	5	5

- No information available

* The investors were asked to send the questionnaire forward

There is a notable division between the answers received from the three categories. Most answers were received from companies then from public sector and least answers was received from investors and banks (exception Kozani, Table 2). The partners also contacted more companies than organisations from the two other categories.

The only partner who managed to reach the target number of answers in all of the three categories was the Finnish partner HAMK. Italian partner Molise and Slovenian partner SVRK were close as they managed to reach the target number of answers in two of the categories (companies and public sector). The most difficult stakeholder group to reach has been investors and banks. The partners own conclusions about not receiving the target number of answers are found later on the report at partner-specific results.

4.1 Over view of the companies

The review to the size of the companies gives a better overview of the sampling that was chosen to the survey. Micro companies are those with less than 10 employees. Small are those with 10 to 49 persons employed and medium –sized companies are those with 20 to 249 persons employed. Large enterprises are the ones with 250 or more employees. Some observation can be made based on the size of the companies:

- With no exception the most replies was received from micro companies
 - The SYMBI partners conducted mostly small organisations
- Possible reason for the higher involvement from micro-sized companies:
 - easier to contact and approach
 - more interest to profit from co-operation (essential in industrial symbiosis)
 - the partners already have more co-operation with local/regional micro companies
 - micro companies struggle less with bureaucracy compared to larger enterprises
- Slovenian partner operates nationally thus the highest amount of answers

- The majority of companies in Slovenia are considered micro and small enterprises, to lesser extent also medium enterprises.
- If empty, the information of the size of the company was unavailable
- Conclusion can be made that micro companies seem to be more interested in the involvement of industrial symbiosis projects and also invest in it at SYMBI partners regions
- A comparison to large companies cannot be made as SYMBI partners contacted mostly small and micro –sized companies.

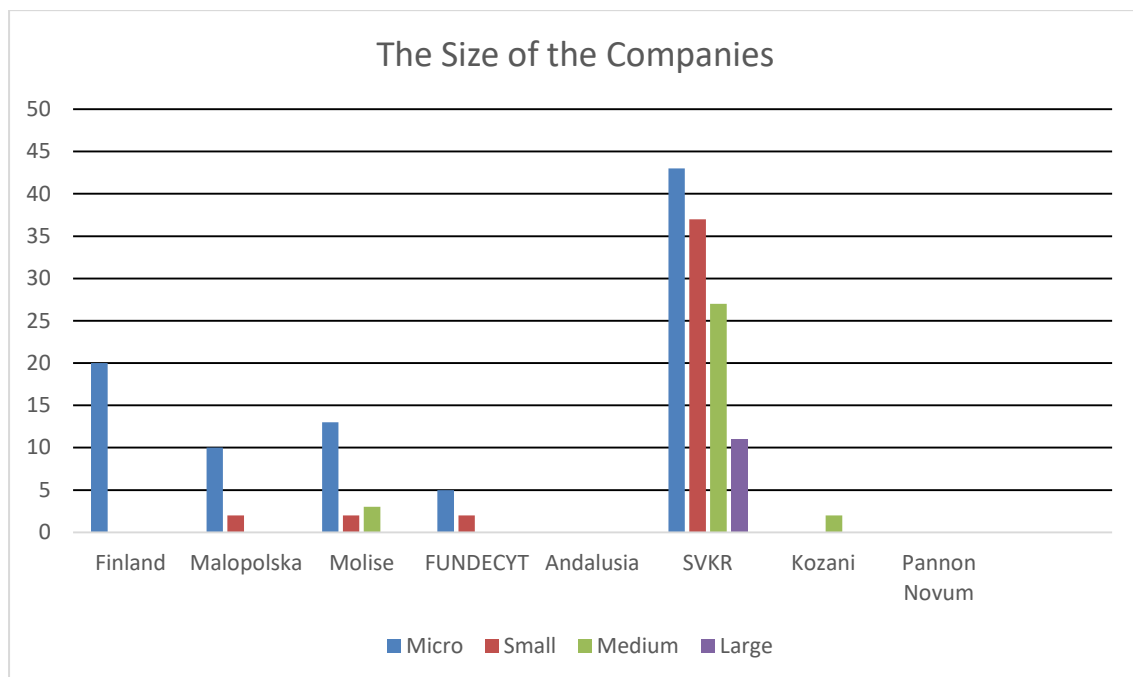


Figure 3. The amount of the companies that took part in the survey classified by size

4.2 FUNDECYT Spain

Foundation FUNDECYT Scientific and Technological Park of Extremadura is a public body agency operating regionally in the Extremadura autonomous community. FUNDECYT selected the coverage of the survey by the existing activity in innovation and relevancy in industrial symbiosis and regional location in the Extremadura region. The questionnaire was sent to the stakeholders via online survey. (Figure 4)

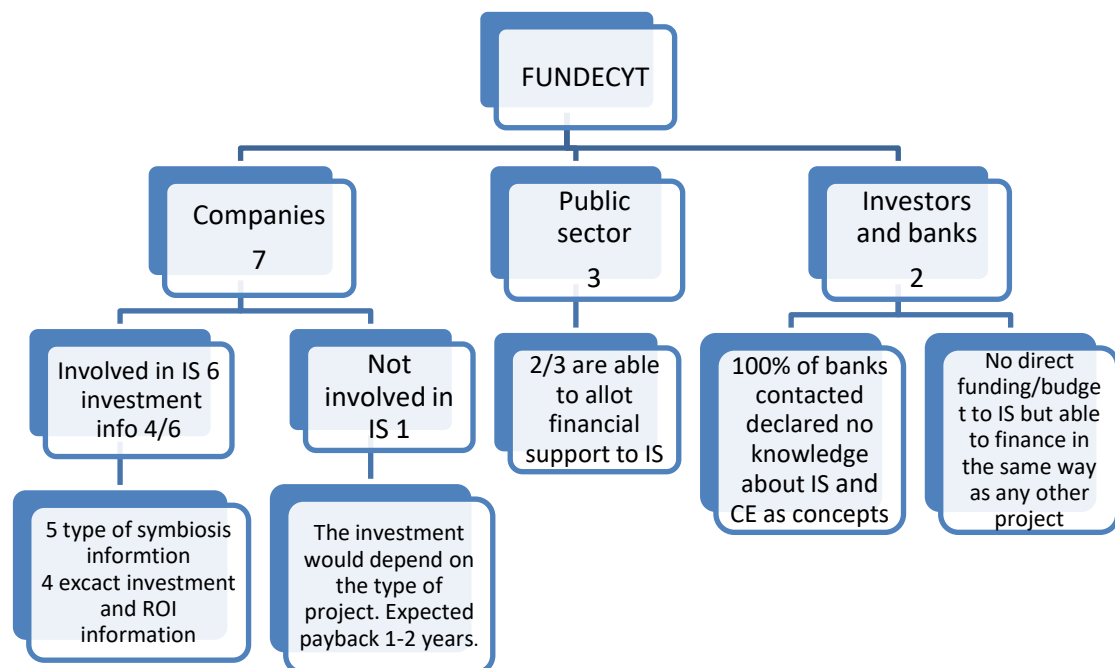


Figure 4. The diversion of the survey results in the three categories

4.2.1 Companies

FUNDECYT approached companies that are already oriented to innovation according to FUNDECYT's databases. FUNDECYT used the original format of research questions when approaching companies. The questionnaire was sent to 250 companies and from the eight

replies they received, seven were analyzable (Table 2). According to FUNDECYT, the companies that answered the questionnaire are already working in topics related to circular economy and are innovative with a high participation in researching activities. Rest of the organizations from which no answer was received appear to have lack of understanding of concepts related to industrial symbiosis and circular economy according to FUNDECYT. Five of the seven organisations who answered the survey are involved in industrial symbiosis and four of these invest in it (Figure 4). The announced investment information varies from around 100.000 euros to 300.000 euros with the payback time of 2-5 years. The one company that is not involved in industrial symbiosis projects stated that the investment would depend on the type of project and expected payback time would be 1-2 years. If the payback time is expected to be as short as 1-2 years, it might be a restricting factor in participating in industrial symbiosis projects as such projects might be harder to find or execute.

Some of the companies reported objectives related to the participation in industrial symbiosis projects. These are:

- To develop a new productive model for the region that is capable of generating value in processes that otherwise would not have it.
- Take advantage of new opportunities.
- Offer products with long life cycles, and products for cascade lifecycles.

4.2.2 Public sector organisations

The study area for public sector organisations was national and chosen from specific departments that count on funds for innovation for companies. FUNDEFYT added questions to the original format of research questions when approaching public sector organisations. The additional questions dealt with having supported investments in industrial symbiosis and circular economy in the past and about the conditions of receiving a fund (Appendix x). The questionnaire was sent to five public sector organisations and three replies were received. Two of the public sector representatives are operating nationally and one regionally in

Extremadura. One of the national organisations is able to allot financial support for companies in creating industrial symbiosis and this has been done through research and development projects and in supporting companies in Horizon 2020. The organisation funds a wide range of research projects but does not have a specific budget for supporting these investments. The condition in getting a fund is research and development activities with a technological challenge and financial capability. The other national public sector organisation does not invest in or support industrial symbiosis projects. The regionally operating public organisation has supported investments in industrial symbiosis or circular economy projects and they are able to allot financial support companies in creating such projects by minority shareholding, participatory loans and conventional loans.

4.2.3 Investors and banks

FUNDECYT approached 10 investors and banks with the survey and received three answers from which two were analyzable (Table 2). Extra questions were added to the beginning of the questionnaire (Appendix x) about the level of knowledge related to circular economy and industrial symbiosis and 100 % of banks contacted declared no knowledge about these concepts. Both of the investment sector organisations have not supported investment in industrial symbiosis or circular economy. However, they stated to be able to allot financial support to companies in creating the two aspects with traditional banking instruments, such as guarantees for credits (Figure 4).

4.2.4 SWOT analysis and conclusions

FUNDECYT managed to achieve the minimum number of answers with public sector but not with companies or investors and banks. According to FUNDECYT, the possible reasons for not achieving the target number of answers is due to a lack of understanding related to the topics. The fact emerged especially from the answers received from investors and banks as they declared to have no knowledge about these concepts.

Based on the results of the survey, some chunks of data can be categorized under the four quadrants of SWOT analysis. Strengths represent the aspects that have a positive impact on investment potential that emerge from the answers and are already present within the organisation and its operation. Such aspects are the generation of value from processes that would not have it in a business as usual situation (waste and side stream), and to create new products from it. Positive experiences from companies in industrial symbiosis projects are met when the investment have been around 100.000 euros to 300.000 euros with the payback time of 2-5 years. At public sector the strengths related to investment potential are the many ways of giving finance especially in the field of innovations and new technology and other ways of supporting industrial symbiosis (IS) and circular economy (CE) projects. The strengths found from investors and banks are that the traditional banking instruments also apply to industrial symbiosis projects.

The Weaknesses are the negative aspects that hinder the investment potential within the organisation. With companies there are many weaknesses hindering the potential to invest IS and CE projects. With companies and investment sector, the most significant weakness is the lack of knowledge of the whole idea of symbiotic cooperation between companies. Lack of understanding creates lack of interest. With public sector the investment seems to be still at a vague stage as they were not able to give any specific investment information. Neither investors nor banks have specific ways of funding IS and CE projects.

Opportunities and threats come from outside of the organisation and are affected by the current and general national and regional situation. A general threat is that if the level of knowledge does not rise the situation might not advance. On the other hand, the level of knowledge acts as an opportunity as by increasing it in any of the three categories it might have a positive effect to the other. Companies seeking funding for IS and CE projects give the investment sector encouragement to create instruments tailored to such action and the availability of funding encourages companies to get involved. The general interest towards such activities gives the public sector regional development possibilities. A threat related to

the investment potential is if the conditions to participate are too strict, for example the expected payback time for investment is relatively short so that the short-term outcome is prioritized over the medium-long-term strategies that might bring profit in the longer run.

<p><u>Strengths</u></p> <p>Companies:</p> <ul style="list-style-type: none"> -to generate value from new process and products -take advantage of new opportunities <p>Public sector:</p> <ul style="list-style-type: none"> -many ways of giving finance -also other supporting instruments such as information tools <p>Investors and banks:</p> <ul style="list-style-type: none"> -same ways of funding companies in general apply also to IS 	<p><u>Weaknesses</u></p> <p>Companies:</p> <ul style="list-style-type: none"> -lack of information and knowledge -lack of understanding and interest - Legislative, technical, economic, commercial (psychological barrier on the products of second uses) - expected payback time too short which might restrict the possibility to participate in IS projects <p>Public sector:</p> <ul style="list-style-type: none"> - no direct investment information <p>Investors and banks:</p> <ul style="list-style-type: none"> - no knowledge about IS and CE - no direct funding instruments for IS or CE
<p><u>Opportunities</u></p> <ul style="list-style-type: none"> - to increase knowledge <p>Companies:</p> <ul style="list-style-type: none"> -take advantage of new opportunities -to offer products with long life cycles, and products for cascade lifecycles <p>Public sector:</p> <ul style="list-style-type: none"> - raise public awareness in a bigger scale <p>Investors and banks:</p>	<p><u>Threats</u></p> <p>Companies:</p> <ul style="list-style-type: none"> - the short-term outcome is prioritized rather than the medium-long-term strategies that need to be adopted when starting cooperation <p>Public sector:</p> <ul style="list-style-type: none"> - lack of activity regarding to IS and CE <p>Investors and banks:</p>

- create specific funding instruments for IS and CE

- if the level of knowledge does not rise rapidly enough, situation might not change

4.3 Andalusia Spain

The second Spanish partner is an Environment and Territory Regional Ministry operating regionally in Andalusia. The organisation is a public body organisation focused on general direction for environmental prevention and quality. Andalusia used the original format of the research questions. The target area of the study was the whole Andalusia region with the aim to contact private and public organisations from all of the Andalusia provinces. Replies came mainly from Seville and Malaga provinces, which are the two largest provinces in Andalusia. The questionnaire was sent to the stakeholders first in English and later on translated to Spanish because of the low level of answers. The assumption from Andalusia was that the stakeholders had difficulties to really understand the aim of the questionnaire as many of them have very low experience related to EU-funded projects. This might be the reason Andalusia received only five answers all together from public (1 answer) and private (4 answers) organisations and failed to reach the target number of answers (Figure 5). Andalusia stated having difficulties in knowing how to address investors and banks so they ended up not approaching the investment sector at all.

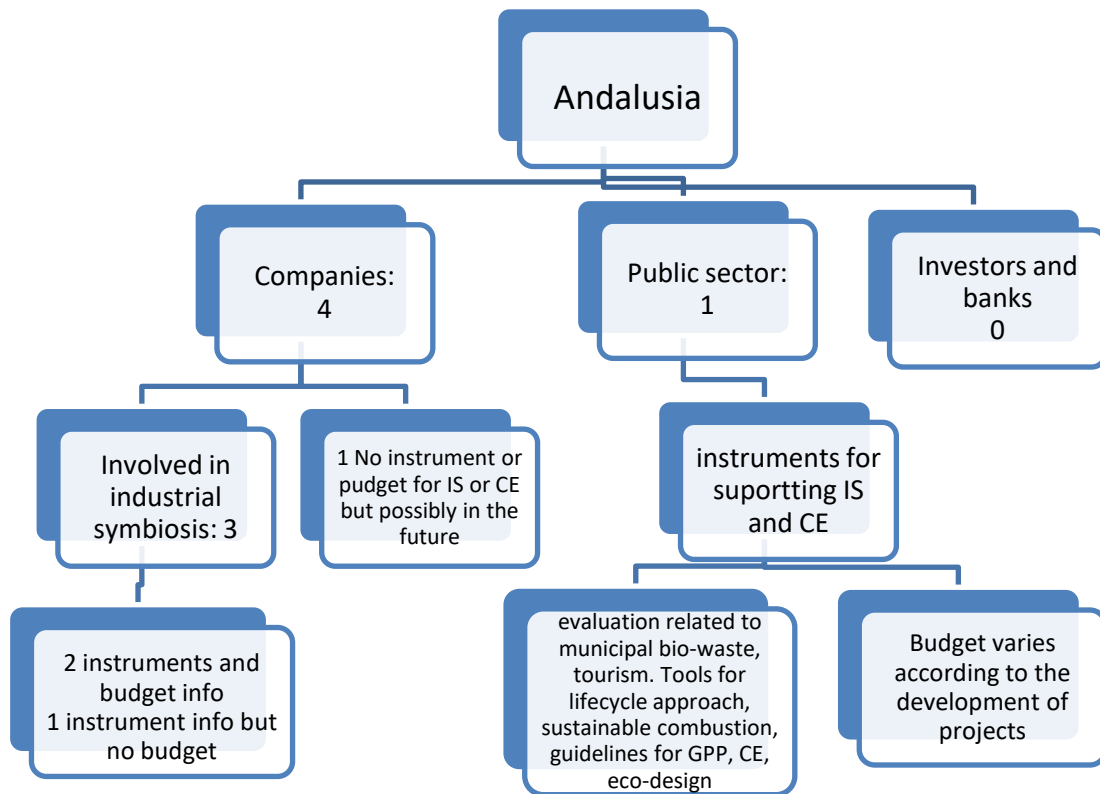


Figure 5. The diversion of the survey results in the three categories

4.3.1 Companies

The questionnaire was sent to 15 companies and four analysable answers were received. Three out of four companies are involved in industrial symbiosis project and two of these invest in industrial symbiosis:

- One of the companies provided investment information from three cases related to steel production and the reuse of ferrous slag.
 1. Case: Investment of 600 000 euro with the payback time of 5,5 years.
 - Represents the ideal situation in which there is free market access for slags in equal conditions than natural aggregates. (Rare in Spain).
 2. Case: Investment of 400 000 euro with the payback time of 2,2 years.

- Represents an intermediate situation, when only 70% of slag produced enters the market as a basic quality aggregate, still with waste status and thus at lower price. In this case and due to the difficulties and barriers, there is not premium quality demand. (Typical case).
3. Case: Investment of 0 euro with the payback time of 1,2 years.
- Shows the situation in which the slag cannot freely enter the market, mainly due to bureaucratic difficulties and the lack of promotion of its use among consumers sectors. These consuming sectors due to the administrative problems involved, ignorance or mistrust decide to acquire natural aggregates instead, even though the steel aggregates amply meets the performance specifications. (Typical case).
 - According to the company the investment, fixed and variable cost and payback times for the three cases above, depends on the access to the market of the secondary raw materials (EAF Slag). The two fundamental variables are the investment cost that is higher or lower depending on the quality of aggregates to produce and the market price. Both are consequence of the legal status and level of access to market of these secondary aggregates. The easier and simpler the access to the market, the more likely it reaches the natural aggregate market price.
 - The company emphasizes that a strong and reliable legal framework is necessary to avoid technical and administrative barriers. Just the investments are not enough, it is necessary to streamline the relations between companies, facilitating the access of secondary raw materials to market in the same conditions than natural resources.
- The other company has a budget for circular economy research and development of 10 million euros for 2016-2020.

One of the organisations have non-monetary ways of supporting industrial symbiosis and circular economy such as co-organizing a Circular Economy day. The aim of the Conference was to analyse the creation and development of green companies and promote Andalusian firms access of research, development and innovation projects funding in this field, as a way to move forward innovation, competitiveness and specialization, and as a result, to generate employment and market opportunities.

4.3.2 Public sector

The questionnaire was sent to eight public sector organisations and one answer was received. The organisation has different tools to support the implementation of circular economy, in the rural, urban and industrial areas through various regional, national and European innovation projects. Budget varies according to the development of projects.

4.3.3 SWOT analysis and conclusions

Andalusian own conclusions about the low level of respond is that it probably was too early in terms of SYMBI project development to expect higher participation from the stakeholders. Methodological documents were still being completed and no stakeholder meeting had yet taken place, so the stakeholders did not know that much about the project. Andalusia supposes they would get much better feedback if the questionnaire had been sent after the project had gain some recognisability. Also the fact that there is general lack of awareness at all stakeholder levels effects the result.

The strengths that emerge from the survey results from companies were about the creating of value with new projects and awareness rising about funding possibilities through a campaign. From the Andalusian results, a main finding can be categorized as a weakness, threat or an opportunity depending on the current market demand, price and the legal status of the material. The access to the market and the market price determines the

investment conditions when dealing with secondary raw materials. With public sector a weakness and a threat is the low level of responds that comes across as low level of interest towards such projects. Opportunities and threats generally lie within the legal framework and level of technical and administrative barriers.

<p><u>Strengths</u></p> <p>Companies:</p> <ul style="list-style-type: none"> - activities among CE and IS present - launch new ideas, services, and projects to obtain social and environmental value - other supporting instruments such as information tools and awareness raising through event organisation <p>Public sector:</p> <ul style="list-style-type: none"> - other supporting instruments such as information tools and awareness raising and evaluation services <p>Investors and banks:</p> <ul style="list-style-type: none"> - no information available 	<p><u>Weaknesses</u></p> <p>Companies:</p> <ul style="list-style-type: none"> - the investment, fixed and variable cost and payback times depends on the access to the market of the secondary raw materials and their legal status - mistrust towards the secondary raw material among consumers - secondary raw material cannot compete equally with - bureaucratic difficulties in entering the market <p>Public sector:</p> <ul style="list-style-type: none"> - no direct investment information <p>Investors and banks:</p> <ul style="list-style-type: none"> - no information available
<p><u>Opportunities</u></p> <ul style="list-style-type: none"> - increase knowledge <p>Companies:</p> <ul style="list-style-type: none"> - the investment, fixed and variable cost and payback times depends on the access to the market of the secondary raw materials and their legal status 	<p><u>Threats</u></p> <p>Companies:</p> <ul style="list-style-type: none"> - technical and administrative barriers hinder investments <p>Public organisations:</p> <ul style="list-style-type: none"> - interest towards such projects appear to be low

<ul style="list-style-type: none"> - facilitate the access of secondary raw materials to market in the same conditions than natural resources <p>Public organisations:</p> <ul style="list-style-type: none"> - create a strong and reliable legal framework to avoid technical and administrative barriers <p>Investors and banks:</p> <ul style="list-style-type: none"> - no information available 	<p>Investors and banks:</p> <ul style="list-style-type: none"> - no information available
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4.4 COC Molise Italy

The Italian partner Chamber of Commerce (COC) of Molise Region is a public body organization supporting regional businesses. COC of Molise selected the stakeholders who were the most interested in the project activities and approached them by sending the survey via email, as online survey and through phone interviews and through meeting one to one in the COC premises. Molise used the original format of research questions. The questionnaire was sent to the stakeholders in Italy and the received answers were translated to English. The coverage was selected from the Molise regional area. The total number of stakeholders approached was altogether from public, private and financial sector about 45 organisations. The ones thought to be the most reactive and interested in the project were selected to participate in the survey. Therefore, the results from COC of Molise represent the most active stakeholders in the field of circular economy and industrial symbiosis. Most of the replies came from Isernia province, which is the smaller province of the two provinces in Molise region. The reason for receiving most answers from Isernia might result from that there is a substantial number of small and medium-sized enterprises active in several fields of economy.

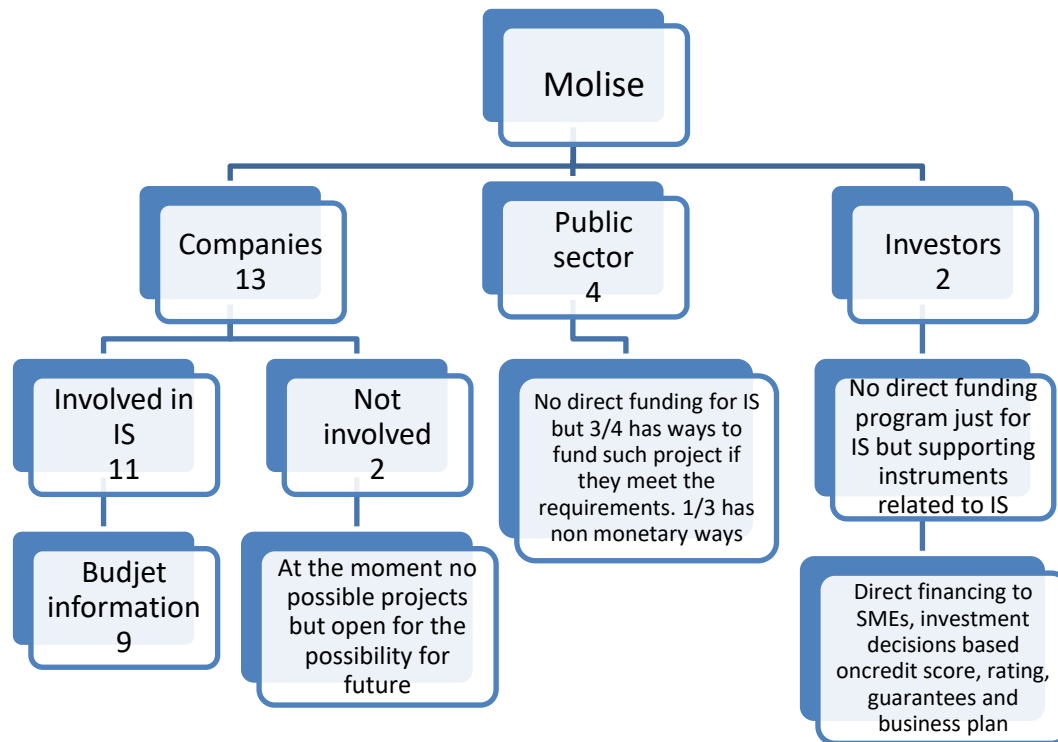


Figure 6. The diversion of the survey results in the three categories in the Molise region

4.4.1 Companies

COC of Molise received most answers from companies and managed to cross the target number of answers in this category. Most of the companies 11/13 are involved in industrial symbiosis (Figure 6). The companies which are not involved in industrial symbiosis at the moment are open for the possibility to invest in industrial symbiosis process in case there was a rapid return on investment or information available about the benefits or revenues of the invest, at least in broad outlines. Investment information from the companies from Molise region were:

- Sharing of secondary resources (bio and technical materials): investment of approximately 1 % of turnover with a 3-5 years of ROI (return on investment).

- Providing bio waste materials: investments for industrial symbiosis amount of 200,000.00 and € 350,000.00 to be achieved by 2017. The estimated ROI time is three years.
- Giving and receiving waste material (technical materials): annual average investment: € 7 / 800,000.00 with a 3-year ROI time.
- Company does apply Industrial Symbiosis in its process but does not invest in it.
- Not possible to quantify the size of investment as all our industrial activity is suited to maximize waste reduction.
- No specific investment dedicated to industrial symbiosis because all the company's production process is covered by the concept of industrial symbiosis.

Five of the respondents operates in the same innovative compost project where a group of companies collaborated in order to obtain a new product from the olive mill wastes. The objective of the project is to study a different way to recycle the production wastes. The project is arranged with the support of the public contribution of the Molise Region. The investments varied from 95.000 to 190.000 euros in 3 and a half years' time.

4.4.2 Public organisations

COC of Molise received four answers from public sector organisations. None of the respondents has direct funding for industrial symbiosis projects but three out of the four has financial ways of supporting companies, especially in the field of innovations and technology. One of the respondents stated that even though the organisation is engaged in industrial symbiosis initiatives they are unable to allocate financial resources to companies. Instead, they have various non-monetary supporting tools such as information tools, like directing enterprises towards possible financing instruments, particularly at EU and national level.

It appears from the answers from public body organisations that the public sector has potential investment channels or at least the knowledge to guide enterprises to these

channels. The reason that these channels are not yet utilized in the field of industrial symbiosis and circular economy may have to do with the lack of information and knowledge regarding these two aspects. According to COC of Molise the survey results reflected the local economic situation, as the responds from public authorities were low.

4.4.3 Investors and banks

COC of Molise received two answers from investors and banks. One reply come from national Italian bank and the other from a financing company offering services for local enterprises at the Molise region. The national bank stated that they do not have direct funding for industrial symbiosis or circular economy but they support companies that implement industrial symbiosis processes through direct funding to small and medium sized enterprises. The bank is also considering the introduction of more direct funding instruments for industrial symbiosis and circular economy however it does not occur from the answer what kind of instruments these would be. The financing company has developed investment instruments related to industrial symbiosis for setting up business networks in which more operators of the same or different sectors can put their resources in common, to boost the economic gains and energy saving. The financial instruments to do so are loans, guarantees, financing the purchase of useful machines to the recovery and processing of waste products.

4.4.4 SWOT analysis and conclusions

According to COC of Molise the survey results reflected the local economic situation, as the responds from public authorities, banks and investors were low. The results from especially financial institutions reflected the lack of attention for circular economy at local and national level even though EU has been trying to promote circular economy as the only solution to waste reduction and reuse of by-products.

Based on the results of the survey, some chunks of data can be categorized under the four quadrants of SWOT analysis. Strengths are that the companies that already invest in industrial symbiosis had mainly positive experiences especially relating to cost decreases in waste disposal and through energy saving. New business actions, products and better control of supply chain were also drivers that the companies brought out. Also environmental aspects such as “industrial symbiosis leads automatically to respect towards environment” and smaller environmental impacts through reducing the amount of waste were mentioned. In addition, the companies that are not yet part of industrial symbiosis would be willing to invest if suitable opportunity come along. The companies emphasized that it is important to assure a clear aim within the companies participating in the industrial symbiosis. All the companies should be very motivated and committed in order to reach the objective. The strengths from public sector are that they possess many ways of giving finance, even though none are direct funding for companies there is ways to support actions in innovation and technology and guide companies to suitable financing. The only result from the survey where investors have created a specific financing instrument to advance industrial symbiosis related cooperation was found from Molise.

The weaknesses and threats had to do with lack of willingness to take risks. The general lack of expertise and information was also present in the results from Molise. A general threat is that if information never spreads the diffusion of industrial symbiosis and circular economy investments might happen too slowly.

<p>Strengths</p> <p>Companies:</p> <ul style="list-style-type: none"> - positive attitude towards financing IS projects (also) in the future - sharing of skills and processes - new business transaction and products - reducing of costs (esp. in waste disposal) 	<p>Weaknesses</p> <p>Companies:</p> <ul style="list-style-type: none"> - no willingness to invest unless there is certainty about revenue/benefits, return of investment which indicates to low level of willingness to take risks - lack of know-how
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<p>and energy saving)</p> <ul style="list-style-type: none"> - better control of supply chain - smaller environmental impact (reducing amount of waste) <p>Public sector:</p> <ul style="list-style-type: none"> - many ways of giving finance especially in the field of innovations and new tech - other supporting instruments such as information tools <p>Investors and banks:</p> <ul style="list-style-type: none"> - direct funding instruments for advancing industrial symbiosis - same ways of funding companies in general apply also to IS 	<ul style="list-style-type: none"> - not enough recompensing to companies acting towards IS <p>Public sector:</p> <ul style="list-style-type: none"> - financing can only happen locally <p>Investors and banks:</p> <ul style="list-style-type: none"> - low level of knowledge about IS and CE - the direct funding instrument for IS is not called in this specific way
<p><u>Opportunities</u></p> <p>Companies:</p> <ul style="list-style-type: none"> - the commitment of the companies participating, clear aims and strong motivation are the keys to success <p>Public sector, Investors and banks:</p> <ul style="list-style-type: none"> - by increasing knowledge and funding instruments the activity among the IS and CE increases 	<p><u>Threats</u></p> <p>Companies:</p> <ul style="list-style-type: none"> - routine activities can overwhelm the entrepreneurs - responsibilities are not clear which leads to lack of the promotion of the initiative - possible lack of motivation and direction <p>Public sector:</p> <ul style="list-style-type: none"> - the diffusion of information happens too slow <p>Investors and banks:</p> <ul style="list-style-type: none"> - IS and CE related financing instruments are not promoted as such

4.5 Malopolska Poland

The Malopolska Region is a regional public authority (one of 16 in Poland). The Malopolska Region received four answers all together, three from companies and one from public sector. Large enterprises that have the highest environmental awareness were the ones approached as they were thought to be the easiest. Principles for selecting the coverage was that activity related to industrial symbiosis especially large industrial establishments and energy sector can be found. The questionnaire was sent via e-mail at the Malopolska region.

The Malopolska Region encountered difficulties receiving a large number of answers from companies and institutions and did not manage to reach the target number of answers and did not receive any answers from investors and banks. The reason for this poor response might be the lack of knowledge about the idea of circular economy and industrial symbiosis. None of the companies and institutions that provided their response answered all of the questions. According to Malopolska, another issue might be that some companies probably do not realize that they are using industrial symbiosis in their facilities. On the other hand, it is difficult to receive an answer from companies which are totally not involved in industrial symbiosis or circular economy. Moreover, many private organisations are not interested in answering any surveys and dedicating their time to activities that do not bring direct profits.

Another comment from the Malopolska Region concerns the national policy on investing in circular economy and industrial symbiosis projects. At the national and regional levels in Poland, there are no dedicated funds from which this kind of projects could be subsidized. The only way is to combine other funds supporting environmental issues like the National and Regional Fund for Environmental Protection and Water Management.

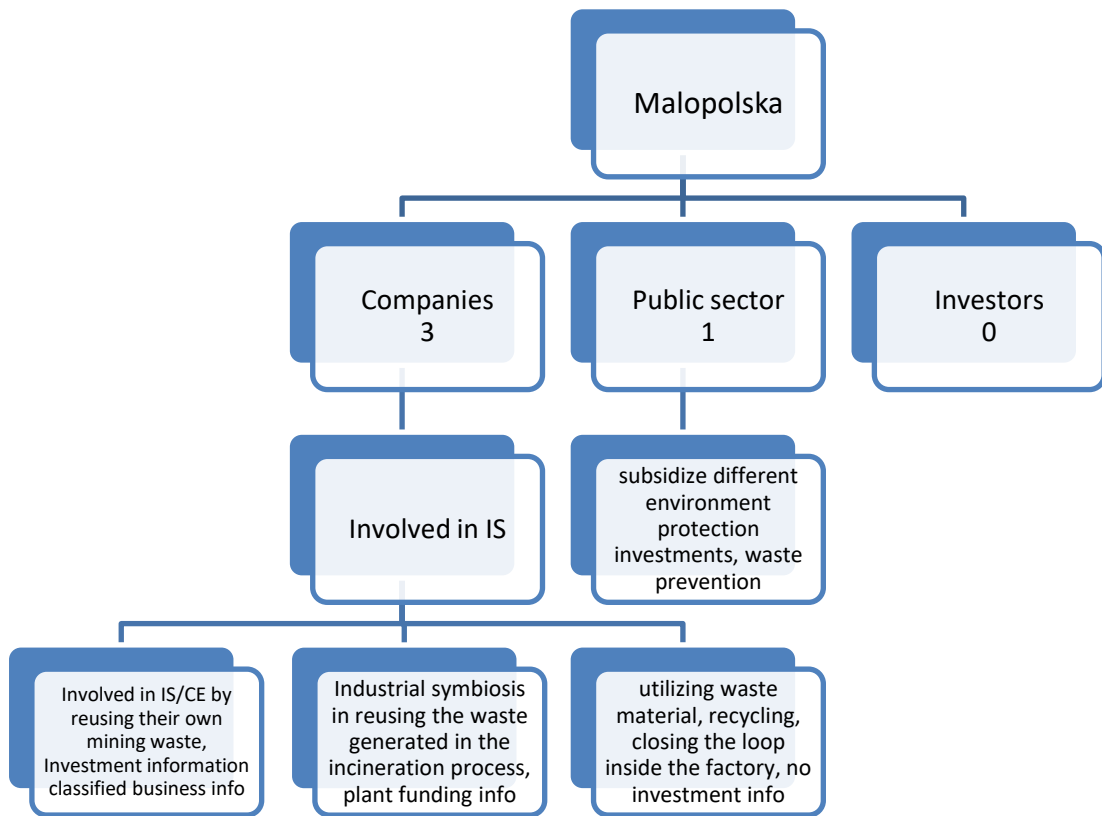


Figure 7. The diversion of the survey results in the three categories in the Malopolska region

4.5.1 Companies

The Malopolska region contacted 16 companies and received three answers, which all were analysable (Table 2). All of the three companies are involved in industrial symbiosis and/or circular economy:

- Zinc and lead mining and metallurgy plant is involved in industrial symbiosis and circular economy by reusing their own mining waste. Investment information is classified business information. Objectives in participating in circular economy and industrial symbiosis is the maximum utilization of primary and secondary input material.
- Industrial symbiosis in reusing the waste generated in the incineration process in the waste incinerating plant –like bottom ashes are reused as a material for roads

construction industry. Scarp is reused as an input material in iron industry. Reuse process consist also of electricity production and waste heat recovery for the municipal heating system purpose. One third of the total cost of the incineration plant was subsidized by the Cohesion fund.

- Circular economy through recycling and using paint waste to produce alternative fuel. Technical water recovery – closing the loop inside the factory. No investment information available.

4.5.2 Public sector

The Malopolska region contacted nine public sector organisations with the survey and received one answer (Table 2). The organisation is a regional fund, which subsidizes different environment protection investments in order to contribute towards Environmental Protection Law. All measures, which could potentially limit the regional waste stream, are entitled to subsidize. The regional fund also subsidize biogas plants which are able to produce electricity and thermal energy and mechanical and automatic municipal waste separation plants with alternative fuel production plants.

4.5.3 Investors and banks

The Malopolska region contacted one organisation from the category investors and banks but did not receive any answers. According to the Malopolska region, this might be due to the lack of knowledge about the idea of circular economy and industrial symbiosis or lack of interest to participate and dedicating their time to activities that do not bring direct profits.

4.5.4 SWOT analysis

Based on the results of the survey, some chunks of data can be categorized under the four quadrants of SWOT analysis. A general strength is the utilization of EU funds and different

environmental protection investments that can be benefited in some cases also in industrial symbiosis and circular economy projects. Lack of knowledge is present also at the Malopolska region. It appears as not knowing anything about the aspects and as not knowing that industrial symbiosis activities are already present within the company's premises. A general weakness and a threat if not fixed is that at the national and regional levels in Poland, there are no dedicated funds from which this kind of projects could be subsidized.

<p><u>Strengths</u></p> <p>Companies:</p> <ul style="list-style-type: none"> - utilization of cohesion Fund <p>Public sector:</p> <ul style="list-style-type: none"> - able to subsidize different environment protection investments <p>Investors and banks:</p> <p>(no information received)</p>	<p><u>Weaknesses</u></p> <p>Companies:</p> <ul style="list-style-type: none"> - lack of knowledge about the idea of circular economy and industrial symbiosis - administration regulations - lack of supporting mechanism for large enterprises -no direct investment information <p>Public sector:</p> <ul style="list-style-type: none"> -no direct investment information - lack of knowledge about the idea of circular economy and industrial symbiosis <p>Investors and banks:</p> <p>(no information received)</p>
<p><u>Opportunities</u></p> <p>Companies:</p> <ul style="list-style-type: none"> - maximum utilization of primary and secondary input material <p>Public sector:</p> <ul style="list-style-type: none"> - create national and / or regional fund to 	<p><u>Threats</u></p> <p>Companies:</p> <ul style="list-style-type: none"> - some companies might not realize that they are using industrial symbiosis in their facilities <p>Public organisations:</p>

<p>encourage such activities</p> <p>Investors and banks: (no information received)</p>	<p>- lack of activity regarding to IS and CE</p> <p>Investors and banks: (no survey data received)</p> <p>- lack of knowledge about IS and CE or lack of interest</p>
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4.6 Kozani Greece

The Greek SYMBI partner is the Municipality of Kozani, a local public development and planning bureau. The organisations approached with the survey were the main stakeholders for Municipality of Kozani for SYMBI project. Coverage area was the Municipality of Kozani area and West Macedonia region. The survey was sent to the stakeholders via e-mail. Kozani used the original format of research questions. Kozani did not manage to reach the target number of answers in the tree categories. One organisation was approached from the investment sector but no answer was received (Figure 8). According to Kozani industrial symbiosis and circular economy concepts are very new in Greece. This is one of the reasons why it is difficult to find stakeholders who understand the meaning of the concepts and would provide accurate answers. This is also, why no SWOT analysis is done from the survey results of Kozani.

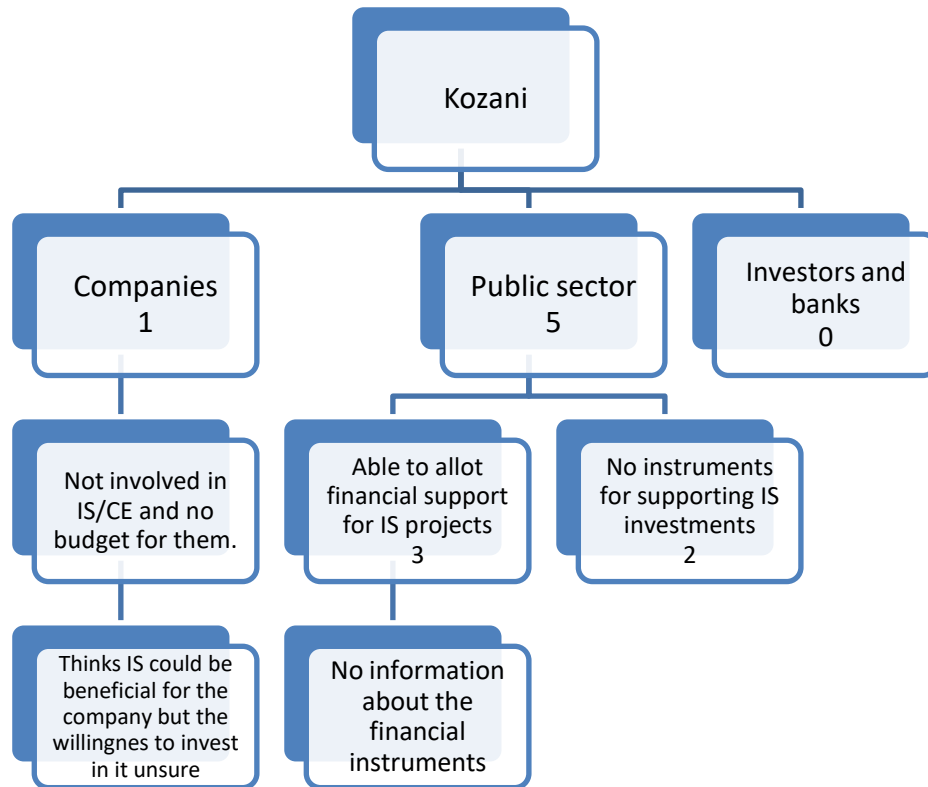


Figure 8. The diversion of the survey results in the three categories

4.6.1 Companies

The municipalities of Kozani sent the survey to two companies and received one answer. The company in question is a waste management company, which is not involved in industrial symbiosis project and does not invest in it. However, the company thinks that the participation in such projects could be beneficial in the future.

4.6.2 Public sector

The municipalities of Kozani sent the survey to five public sector organisations and received answers from all of the organisations. Two of the organisations are not involved or does not have budgets or instruments in supporting industrial symbiosis or circular economy. Rest of

the organisations are able to allot financial support to companies in creating industrial symbiosis. The public body organisation are:

- a development agency,
- a centre for research and technology,
- a regional public body.

4.7 SVRK Slovenia

Slovenian Government Office for Development and European Cohesion Policy (GODC) is a national public authority focused on development policies. GODC is the only SYMBI partner that operates nationally which explains the largest number of answers received among the SYMBI partners. The survey was sent to stakeholders from all 12 Slovenian statistical regions. SVRK elaborated the original format of research questions and added extra ones to get more accurate information (appendix x) thus also the more specific and informative observations of the Slovenian results. The questionnaire was sent via online survey and it was publicly available SVRK's website. The target number of answers was achieved with companies and public sector but not with investors and banks (Figure 9).

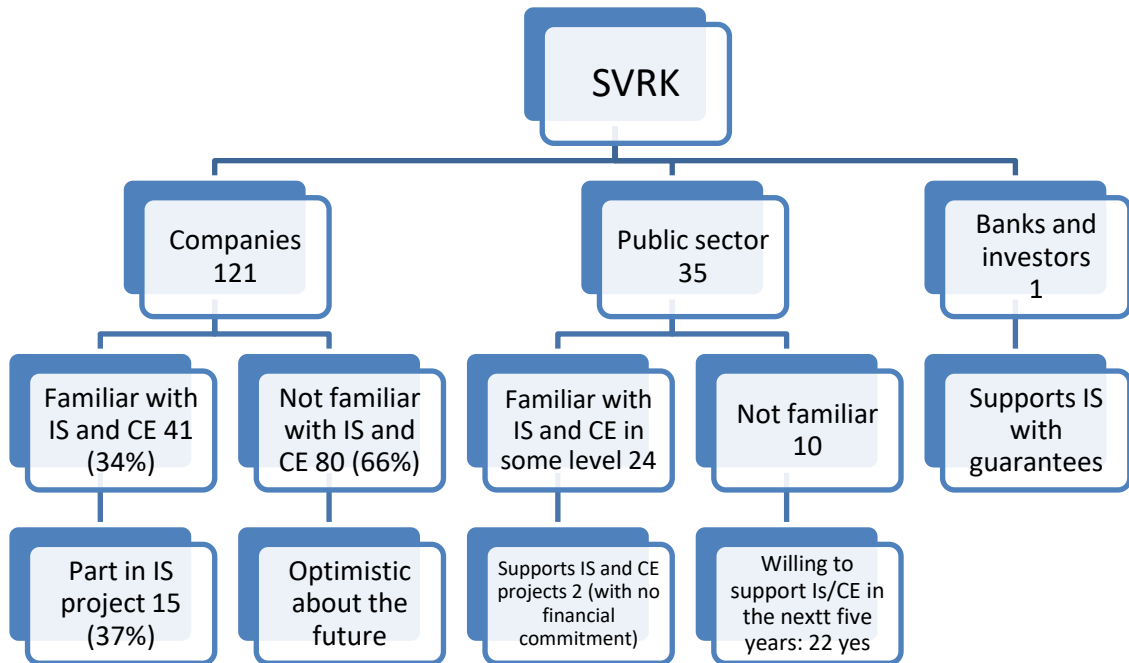


Figure 9. The diversion of the survey results in the three categories

4.7.1 Companies

The questionnaire was sent directly to over 2.000 recipients (i. e. companies) in all Slovenian statistical regions. The information was also sent via various other channels, such as chamber of commerce, regional development agencies etc., asking them to further disseminate the information about the survey. The results and feedback show that the majority of the surveys were collected around three major Slovenian cities, namely Ljubljana (corresponding to “Osrednjeslovenska” region), Maribor (corresponding to “Podravska”) and Celje (corresponding to “Savinjska” region). Results also confirm the balanced distribution of answers around regions.

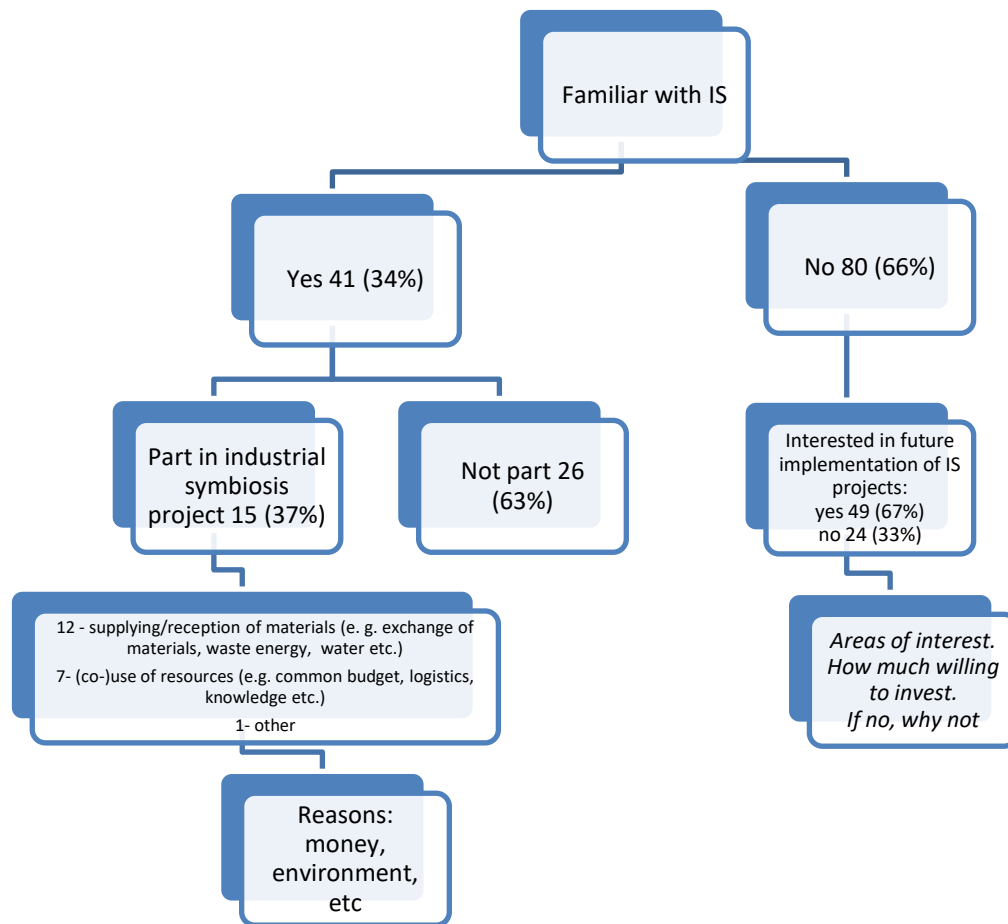


Figure 10. The diversion of the survey results from companies

Most of the companies SVKR received feedback from (66 %) were not familiar with the concept of industrial symbiosis. When they were asked that now that they are informed about the concept do they think that the implementation of such projects would be beneficial for the company and would they be willing to support it, 49 opted yes and 24 no. Most (67 %) of companies would be willing to support projects related to industrial symbiosis. Based on answers SVKR assume that with more promotion activities and incentives, companies would be willing to support such projects. The areas the companies stated to be interested in were (multiple answers were possible):

- 29 answers: supplying/reception of materials (e.g. exchange of materials, waste energy, water etc.)

- 27 answers: (co-)use of resources (e.g. common budget, logistics, knowledge etc.)
- 4 answers: “other”, such as:
 - *Common procurement.*
 - *Our activity is consultancy and planning.*
 - *Information and technological infrastructure.*
 - *Use of knowledge in new projects.*

Based on the results of this question it is notable that companies interests are equally distributed between the two categories of the type of symbiosis, which can lead to a conclusion that industrial symbiosis should be equally developing and promoting all relevant areas. The amount of money the companies would be willing to invest in industrial symbiosis projects was divided to three categories:

1. Numerical, ranging from 1.000 EUR to 25.000 EUR.
2. Percentages, ranging from 0,5 % to 10 %.
3. Depends on projects and its budget.

The companies that stated that even when informed about industrial symbiosis, the implementation of such projects would not be beneficial for the company and therefore would not be willing to support it, gave multiple reasons for it. The most common reason had to do with the experience that the nature of the organisation is not suitable for such projects:

- We are dealing with different activity.
- We are service sector, no such options.
- We do not produce anything like this.
- We do not have similar products.
- Our products are made out of our factory.
- We recycle the metal that we produce.
- No economy of scale.
- Lack of information about the topic, Slovenian cooperation culture is low.
- We do not see cooperation possibilities in our case.
- We do not have appropriate waste.

- We use most of our waste and side products.
- We have very few waste or side products (1 family basket per week).
- We are not ready as society for such synergies.
- We doubt that our incoming materials are waste of another industry.

From the 41 companies that were familiar with the concept of industrial symbiosis (34 %, Figure 10), 15 were also part of industrial symbiosis project. The financing of these projects was from different EU financial mechanisms. The area of industrial symbiosis the projects were about was mostly about supplying and/or receiving materials, (multiple answers were possible):

- 12 answers: supplying/reception of materials (e. g. exchange of materials, waste energy, water etc.)
- 7 answers: (co-)use of resources (e.g. common budget, logistics, knowledge etc.)
- 1 answer: benefiting synergies and development of new products.

One of the additional questions targeted the reason for participating in industrial symbiosis project. Closing the material loop and waste management and other types cost decreases were the most common reasons:

- Optimal development of science, economy and society, inclusion and diversity.
- Waste management, cost decrease and cooperation.
- Closing the material lifecycle, looking for new opportunities and development of new value chain.
- Reducing deposited metallurgical waste.
- Recycling and circular economy are economic and environmental need and the only alternative of regional development.
- Cause we are interested in circular economy.
- Better use of biomass.
- New knowledge, mutual exchange of knowledge with the aim to develop new products.
- Legislation and awareness to protect the environment.

- Reducing different types of costs.

The obstacles the companies reported to have faced when implementing these projects had in most cases to do with problem in forming a partnership with other companies. Also obstacles related to human and public body resources and prevalent price level were notable. All the received answers:

- Incomprehension of less developed partners that do not see the added value.
- Partner search, lack of trust and knowledge about potentials.
- Not enough use of secondary materials in civil engineering
- Incomprehension of companies.
- Government's poor reaction to needs in economy.
- Human resources are overloaded.
- High costs of recycling, transport and destruction of goods.
- Logistical problems.

The companies were also asked about the amount of money they have invested in industrial symbiosis projects in the last five years (in EUR). Six numerical answers were received. Many answers were "Do not know". When asked about the average period of redemption of investment with these projects, only two numerical answers were received, one stating 2 years, second stating 5 years. In addition, there were two answers where companies could not estimate the period. When asked about the plan to invest in industrial symbiosis projects also in the coming five years, only nine answers were received but all of them were positive. The amount of money the companies planned to invest in industrial symbiosis projects in the next five years varied from 10.000 to 250.000 EUR. Non-numerical answers were that the investment depends on legislation and incentives for bioeconomy and that "In this perspective there will be 80 % of projects in this field, meaning that amounts are around several million Euros".

From the 41 companies that stated to be familiar with industrial symbiosis as a concept, 26 were not part of such project at the moment. The reasons for not being part of industrial

symbiosis had mostly to do with lack of information and knowledge about such projects and that the representative felt that the nature of the organisation does not provide opportunities to join them:

- Nature of the organization.
- No real opportunity in the past, with our activity, we do not produce much waste.
- Due to typology of work, we do not produce side products (waste).
- We are understaffed.
- We sell the waste (as a side product) to China through the preponderant of the company.
- I hear for that for the first time.
- We have not received the offer.
- We have no other side products but the metal, which we reuse in our company.
- We have not detected the need.
- We are not informed about this project.
- Due to overwork, we cannot manage this.
- We do not know the project.
- Lack of information.
- Still in a decision making process.
- We have just been informed about it.
- We use the side products to heat the rooms.
- We have no conditions for this.
- We are currently working on other projects.

4.7.2 Public sector

SVRK targeted and addressed the public sector in all Slovenian statistical regions. Majority of respondents came from two (south)eastern regions (i. e. Pomurska and Jugovzhodna) which are considered less developed in comparison to central and west regions. SVRK assumes that there is a higher interest in these less developed regions to find new potentials for growth

and development, therefore public sector in these regions are more inclined to new concepts and ideas. In total, the survey was sent directly to 250 recipients and 141 answers were received, out of which 35 were analyzable.

Most of the public sector organisations were partially familiar with the concepts of industrial symbiosis and circular economy. However, the answers show that a small proportion of public institutions are fully familiar with the concepts (Figure 11). There is thus a room for information and dissemination activities in order to equip them with the necessary knowledge about these two concepts.

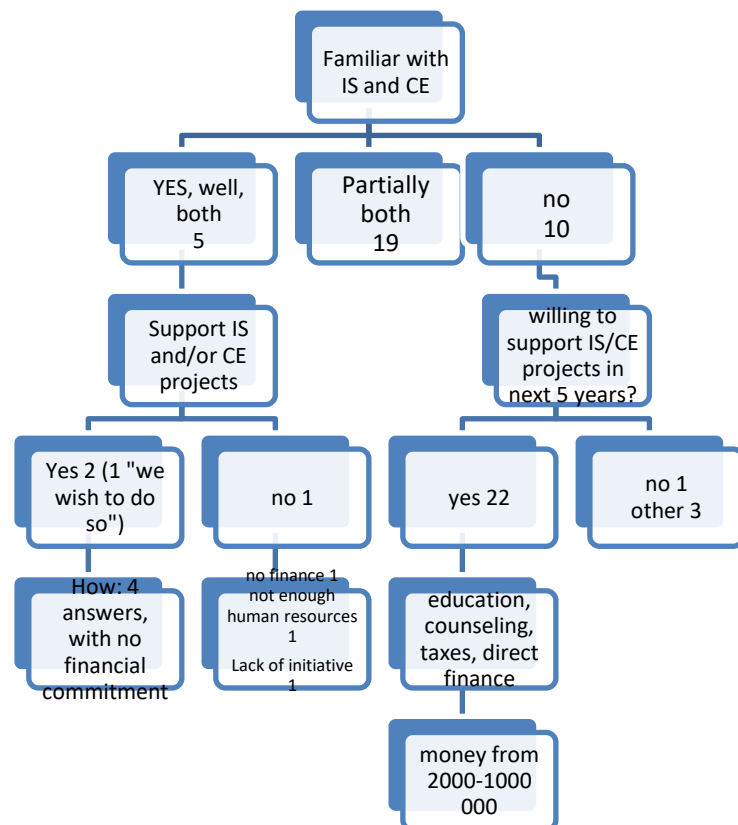


Figure 11. The diversion of the survey results from public sector

From the public sector organisations that were familiar with the concepts of industrial symbiosis and circular economy, only four answered the questions about supporting such projects. Two opted “yes”, one “no” and one “other”, meaning that they wish to do so in the future (Figure 11). The way the public body respondents stated to support such projects were all related to non-financial commitment:

- Education / training and information activities (2 answers).
- Setting up standards (1 answer).
- Supportive environment / counselling (1 answer).

Public body organisations were to list the key criteria, based on which they decide to allocate the support and only one answer was received: *maturity of companies, their understanding, sample group and representation of different areas, company size, sharing and accepting values, recognition of added value in this field*. Only one answer was received for the next three questions related to the investment information:

1. *How much money you have allocated on yearly basis for this type of projects in the past 5 years: 15.000 EUR*
2. *Will you continue supporting projects in circular economy and / or industrial symbiosis also in the coming 5 years?: Yes*
3. *How much money you will allocate for this area in the next 5 years (or next year if you cannot state the mid-term plans)?: 100.000 EUR in year 2017*

The public body organisations stated reasons for not supporting projects related to circular economy and industrial symbiosis as “we do not have financial resources available, we do not have enough human resources, lack of initiative in private sector”. However, most of the public body organisations that opted being only partially or not at all familiar with the two concepts, were positive about the future as 22/29 would be willing to support such projects in the next five years. Only one stated not to be willing to support such projects as they believed that municipality does not have competences. In addition, three “other” answers was received:

- Maybe

- We cannot influence on a decision, but we can suggest to the management to secure the financial resources in the budget, where the budget needs to be approved by the Municipality's council.
- Is financial support of local communities allowed and is this kind of financing foreseen in the system for financing the municipalities?

The type of projects the public organisations would be willing to support in the next five years were (multiple answers were possible):

- Education / training and information activities (15 answers)
- Supportive environment/counseling (11 answers)
- Remission of paying taxes/other contributions (8 answers)
- Direct financial support to companies (7 answers)
- Tax relief (5 answers)
- Setting up standards (2 answers)

The amount of money the organisations stated to be willing to invest in the next five years varied from 2.000 to 1.000.000 EUR. Descriptive answers such as “don’t know, depends on the possibility of cooperation, work of employees” were also provided.

The amount of answers was so low that the results only represent the situation in the few organisations that provided the answers and can not be generalised to represent the whole group. In bigger picture, some generalizable conclusions can be made related to the lack of activity. The low level of answers can reflect the low level of information and participation in such projects and the fact that public body organisations rarely ensure financial-related benefits to projects on circular economy and industrial symbiosis.

4.7.3 Investors and banks

SVRK received 31 answers from investors and banks (Table 2), out of which only 2 were valid and only one questionnaire was complete. SVRK approached the stakeholders also via phone calls to encourage them to fill in the questionnaire but they were unwilling to participate, which shows that the interest among the potential investors is relatively low/non existing.

The one investment company stated to know both concepts and to be a part of such projects. The instruments used to support the projects are guarantees and favorable loans. The criteria used when deciding which projects to support was stated to be “the companies own criteria”. The company also plans to support circular economy and industrial symbiosis projects in the next five years.

4.7.4 SWOT analysis and conclusions

Based on the results of the survey, some chunks of data can be categorized under the four quadrants of SWOT analysis. Strengths represent the aspects that have a positive impact on investment potential that emerge from the answers and are already present within the organisation and its operation. Weaknesses are the negative aspects that hinder the investment potential within the organisation. Opportunities and threats come from the outside and are affected by the current and general national and regional situation.

From the Slovenian answers, a strong interest towards industrial symbiosis and circular economy projects is notable. According to SVRK based on additional observations and particularly in-person conversations, a vibrant interest among stakeholders to take part of similar projects was present, since they are recognizing the importance and potential of circular economy and industrial symbiosis. Moreover, projects are seen as a solid basis for networking and getting in touch with relevant stakeholders.

<u>Strengths</u>	<u>Weaknesses</u>
<p>Companies:</p> <ul style="list-style-type: none"> - many different EU financial mechanisms utilized - closing the material lifecycle, looking for new opportunities and development of new value chain and products 	<p>Companies:</p> <ul style="list-style-type: none"> - lack of knowledge about the concepts of IS and CE - partner search, lack of trust, equality and knowledge about potentials - government's poor reaction to needs in

<ul style="list-style-type: none"> - recycling and circular economy serve the economic and environmental need - cooperation and the exchange of knowledge - legislation and awareness to protect the environment - reducing different types of costs, especially in waste management - reduction of waste and better use of resources <p>Public sector:</p> <p>-also non-monetary ways of supporting IS</p> <p>Investors and banks:</p> <ul style="list-style-type: none"> - IS and CE as concepts are familiar - already support projects in the field of IS and CE - some traditional banking instruments are suitable for supporting industrial symbiosis and circular economy (such as guarantees and favorable loans) 	<p>economy</p> <ul style="list-style-type: none"> - human resources are overloaded - high costs of recycling, transport and destruction of goods - logistic problems (geographical dispersion of companies) <p>Public sector:</p> <ul style="list-style-type: none"> - a small proportion of public institutions are fully familiar with the concept of CE and IS - assumption is that public entities do not or rarely ensure the financial-related support to projects on circular economy and industrial symbiosis - lack of initiative in private sector - lack of capability affect the budget -organizational believe that municipality does not have competences - lack of finance <p>Investors and banks:</p> <ul style="list-style-type: none"> - the interest among the potential investors is relatively low/non existing
<p><u>Opportunities</u></p> <p>Companies:</p> <ul style="list-style-type: none"> - plans to invest in IS projects in the next 5 years - investment depends on legislation and incentives for different areas (e.g. 	<p><u>Threats</u></p> <p>Not enough knowledge about the advantages and concept of IS and CE</p> <p>Companies:</p> <ul style="list-style-type: none"> - investment depends on legislation and incentives for different areas (e.g.

<p>bioeconomy)</p> <p>Public sector:</p> <ul style="list-style-type: none"> - willingness to support IS in the future is present <p>Investors and banks:</p> <ul style="list-style-type: none"> - the plan is to support IS and CE projects in the next 5 years 	<p>bioeconomy)</p> <p>Public sector:</p> <ul style="list-style-type: none"> - willingness to support is minor <p>Investors and banks:</p> <ul style="list-style-type: none"> - the interest among the potential investors is relatively low/non existing
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4.8 HAMK Finland

Häme University of Applied Sciences (HAMK) is a higher education organisation operating in the Häme region. HAMK is a public education and research institution. HAMK used the original format of the survey when approaching the stakeholders. The stakeholders were approached via email that entailed a link to an online survey. HAMK managed to reach the target number of answers in all of the three categories (Figure 13).

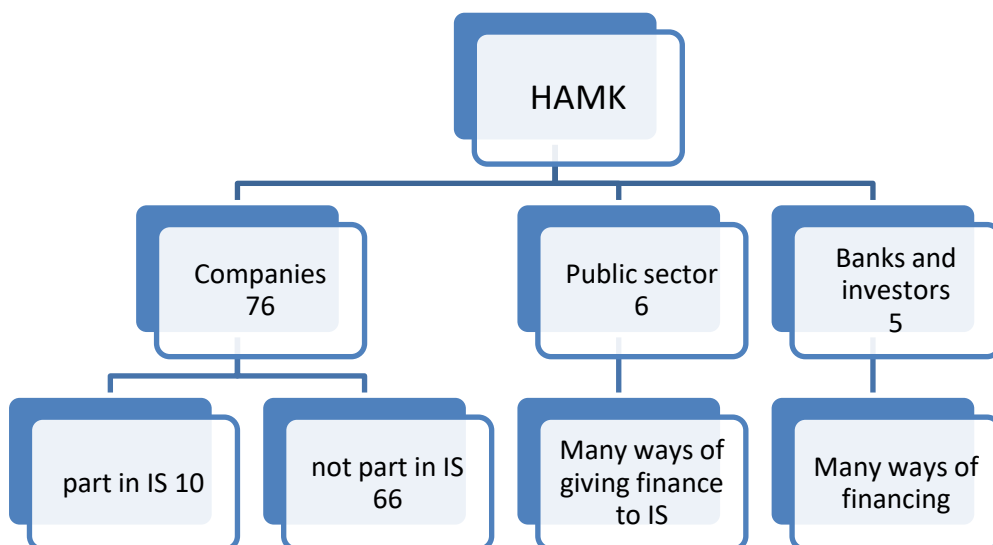


Figure 13. The diversion of the survey results in the three categories from Häme region

4.8.1 Companies

The survey was sent to 3067 companies from which 76 analysable answers was received. The first mailing was as an attachment of The Federation of Finnish Enterprises (Häme region) newsletter. Because of the low number of answers, the link to the survey was sent again to more specific group of companies (the exact extent of the delivery is not documented). From the analysable answers, 20 represented companies from service sector and therefore were excluded from analysis as SYMBI is focused in material industrial symbiosis only. From the companies that participated the survey, 10 were involved in industrial symbiosis projects, however also four of these reported symbiosis were service related. The investment information related to the current industrial symbiosis projects varied from 0 to 15,3 M EUR and the estimated payback time for the investment varied from three months to 10 years. The industrial symbiosis projects were about:

- We give steel chip and scrap to scrapyards for free or for minimum price. Can subcontracting chain be called as industrial symbiosis? We consider that as normal business activity.
- Receiving recycled raw material.
- Procurement of new research equipment.
- Giving
- Reclaiming and reprocessing of others waste and side products as raw material or energy
- Our sport centre has a room for gym instructor. Instructor is using the room only few evenings of the week. We started to rent the room also for two massage therapist at times that are free from gym instructor.

It is notable from the answers that some of the companies did not fully understand what industrial symbiosis is about and described typical transactions between companies or did not know that they were actually already involved in industrial symbiosis. None of the companies was involved in specific industrial symbiosis projects. Within the survey, the first symbiosis about sharing working premises was reported.

The companies were asked about the objectives, obstacles or drivers involved in industrial symbiosis according their experience. Obstacles reported, were about the difficulties related to problems in cooperation and then again, objectives and drivers were about the extra value that cooperation brings:

- Jealousy / envy. (obstacle)
- Combining complementary technologies. Cooperation of companies. Producing more comprehensive services to customers. (Growth. Competitiveness.) (objectives, drivers)
- Profitability of SMEs (objective)
- The problem is that you are “married” to another company if you cannot pay the loan in time. (obstacle)
- Objectives are to get carried out the work performance from the subscriber to the highest quality. Obstacles: none so far.
- Stiffness in municipal sector concerning work carried out subcontracting. (obstacles)
- Economic indicators. (drivers)

The 66 companies that were not involved in industrial symbiosis (Figure 13 and 14) were asked if they thought industrial symbiosis could be beneficial for their company and what the symbiosis would be about: giving/receiving materials or utilizing/sharing other resources. The amount of answers received was 34, but only nine were relevant. Most of them dealt with giving waste and left over materials:

- At times we have left over newspapers and other prints, volume varies from few hundred to a couple of thousand.
- Recycling waste and food loss/spoilage to e.g. energy. Giving spoilage products to reuse. Packing material could be reused/recycled.
- We are interested for example sharing machine resources.
- Recyclable furniture.
- Hard metal waste.
- Sharing of materials coming from building/demolition could be possible
- wood, metal.

- Straw, vegetable waste.
- We are producing wood-based waste that we cannot use our self for example in heating.

When asked about the willingness to invest in industrial symbiosis (EUR and or the percentage of revenue) and about the expected time for pay back the amount of answers was 31, from which 11 were willing to invest:

- 1 %
- We are willing to invest, if the time for payback is one or two years and the investment can be utilized for long time
- 3 % of revenue, 2 years payback period
- 5 %, 3 years
- yes, hard to say in euros, but good idea pays to be involved, 5 years payback period
- 1000 €, 6 months
- Depending on a project, we can be involved in gathering private investment capital for building IS. Capital input can be 20-20000 €, 5-8% interest rate, for 3–5 years and input corresponding holding in symbiosis during the investment.
- 20 %
- Yes, from my own work contribution.
- Max. 1000-1500 €/year and payment should be in several part payment. Provided that investment will be profitable.
- 1000 € per year

The objectives, obstacles and drivers among the companies who had not been involved in industrial symbiosis were mostly about the lack of knowledge and understanding related to the subject in general. All together 27 answers were received:

- Lack of knowledge, fear of competition.
- Lack of knowledge, lack of vision, lack of partners.
- Objectives are high. Obstacles are legislation and expensive investment costs.
- What means IS or driver? I have experience but I do not understand the terms used.
- Financing, coordination, time management.

- Symbiosis traditionally need a leading company strong enough (motivated and persistent) and partner companies with similar attitude. Often the problem is to find suitable partners that find it beneficial to be involved in symbiosis. Effective drivers are common vision of the development path that includes also economical aims and indicators for all parties and actions.
- Obstacles are perhaps in locked attitude and lack of creative thinking.
- Lack of knowledge and networks.
- The whole idea of IS is unfamiliar. Need for information about IS and possibilities for small business. More networking with other entrepreneurs touching my subject field.
- Obstacles are lack of cooperation and finding a common will. Cooperation does not work unless everyone feels equal.
- Lack of knowledge.

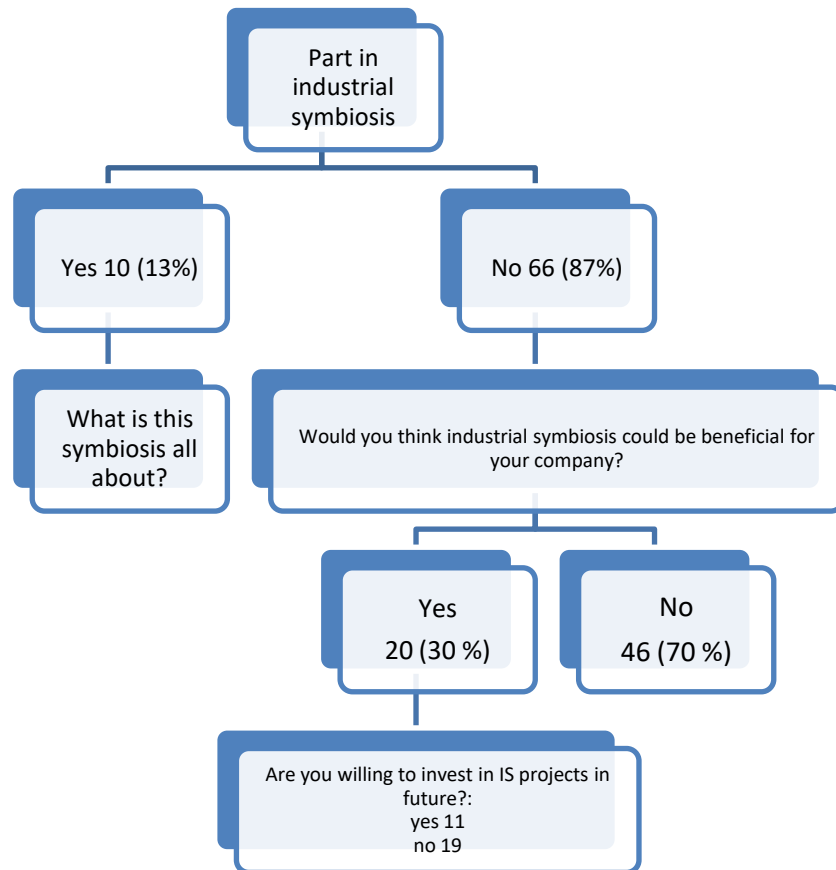


Figure 14. The diversion of the survey results from companies from Häme region

4.8.2 Public sector

The survey was sent to 19 public sector organisations and six answers was received. Three of the respondents were municipal, one regional and two national organisations. Three of the public body organisations stated not being able to allot financial support for companies in creating industrial symbiosis and three stated having some ways of financing such projects:

- Allowance can be granted for investment that encourages export activity assuming that actions are commercially profitable. Allowance cannot be granted to business group or consortium.
- We have allot financial support for building up and coordinating FISS (Finnish Industrial Symbiosis System) operations model in several years as part of Motiva Ltd.

Environmental ministry is also involved in FISU network (resource wise municipalities).

- We have a possibility to attend with municipal funding for actions that support municipal or region. Targeting of funding is not precisely defined.

The public sector also has many other ways of supporting companies in their activities among circular economy and / or industrial symbiosis investments:

- Business development services such as business analysis and consulting.
- We are active in promoting CE development in Riihimäki municipality with several measures. We offer suitable building sites, promote cooperation between municipal workshops and recycling centre and other actors (e.g. Ekokem, Pari-Materia, Suomen Kelapalautus, Salvation Army). We are searching for new complementary businesses to our CE network.
- Waste and environmental legislation, special funding for development and pilot projects.
- Funding of different development projects (no funding for companies).
- Expertise that can be used in common projects. Experience on applying funding. Experience in facilitation (e.g. HINKU –project, The Carbon Neutral Municipalities project).
- Most relevant way of support relates to utilizing of different networks (regional, national and international). Option to reflect actions through different peer actors.

The public sector has several ways of giving finance to companies that bring profit to the region. In addition, many other ways of supporting companies in finding investment are present in the Häme region.

4.8.3 Investors and banks

The survey was sent to 18 investors and banks and 5 answers was received. Two of the respondents stated not having financing instruments to support industrial symbiosis and

circular economy. Three of the organisations reported some traditional banking instruments that are particularly tailored for SME enterprises:

- angel investments for start-up companies, especially on food industry
- In principle all parties apply funding themselves. For example, Tekes (the Finnish Funding Agency for Innovation) has funding for group projects. In addition, project-financing models can be suitable.
- Each credit decision is done considering company applying for funding, project, collateral available and financing in question. In this way, also the best financing product is selected. The financing tool can be IOU financing, limit loan, investment or working capital loan, warranty or the combination of these.

4.8.4 SWOT analysis and conclusions

In general, especially the survey results from companies showed a lack of knowledge towards industrial symbiosis. Many companies operating in the field of services took part in the survey, which might distort the result, as they do not belong to the target group of the survey nor the project. In the Häme region, the organisations were sceptical towards the idea of starting cooperation with other companies and organisations. A fear of the operation being unequal and not finding a common will were present in the answers. In addition, the legislative obstacles and expensive investment costs were mentioned in several answers.

<u>Strengths</u>	<u>Weaknesses</u>
<p>Companies:</p> <ul style="list-style-type: none"> - cooperation <p>Public sector:</p>	<p>Companies:</p> <ul style="list-style-type: none"> - lack of knowledge and networks - fear of competition - lack of partners and leaders

<ul style="list-style-type: none"> - allowance can be granted for investment that encourages export activity assuming that actions are commercially profitable - also other ways of supporting companies in development among IS and CE: business development services such as business analysis and consulting <p>Investors and banks:</p> <ul style="list-style-type: none"> - many instruments for supporting IS and CE: angel investments for start-up companies, especially on food industry and funding for group projects 	<ul style="list-style-type: none"> - legislative obstacles and expensive investment costs - financing, coordination, time management (lack of vision) - locked attitude and lack of creative thinking - lack of cooperation and finding a common will, fear of inequality <p>Public sector:</p> <ul style="list-style-type: none"> - Allowance cannot be granted to business group or consortium. <p>Investors and banks:</p> <ul style="list-style-type: none"> -no specific funding instruments for IS and CE -many companies have no instruments for supporting IS and CE
<p><u>Opportunities</u></p> <p>Companies:</p> <ul style="list-style-type: none"> - interest and unutilized resources available <p>Public sector:</p> <ul style="list-style-type: none"> - rise awareness <p>Investors and banks:</p> <ul style="list-style-type: none"> - further develop funding instruments in amount and quality 	<p><u>Threats</u></p> <p>Companies:</p> <ul style="list-style-type: none"> - the term “symbiosis” is too difficult to comprehend - the fear of losing independency prevents the start of cooperation <p>Public sector:</p> <ul style="list-style-type: none"> - funding is too short term and not available for companies <p>Investors and banks:</p> <ul style="list-style-type: none"> - lack of interest prevents the development of funding instruments for IS and CE



5 Mapping the investment potential in industrial symbiosis – SWOT analysis of survey data

Many of the partner-specific survey results entailed similarities. A common SWOT analysis can be made to summarise the results of the survey. The main critique that SWOT analysis faces is about it being too simple, just a "laundry list" put together under each of the four headings. SWOT indicates the aspects that effect the analysed matter from inside and out but does not tell what to do next and how exactly the outcome of this analysis can help the analyst in its development. For this purpose, an 8-fold SWOT has been created. The 8-fold matrix has four quadrants for the fisting of strengths, weaknesses, opportunities and threats and in addition to this there is four quadrants for the actions that should be made based on the results (Figure 15).

Internal

Strengths

Companies:

- different EU financial mechanisms utilized
- Reducing different types of costs, especially in waste management
- Reduction of waste
- Closing the material lifecycle, looking for new opportunities and development of new value chain and products
- cooperation and the exchange of knowledge

Public sector:

- many ways of giving finance
- also other ways of supporting IS and CE (guiding to finance, awareness rising)

Investors and banks:

- are able to finance IS and CE through traditional investment instruments
- some trends of customising investment specifically for IS and CE

Weaknesses

Companies:

- Lack of knowledge and partners
- Cooperation difficulties: challenging to find right partners, equality, division of responsibilities,
- Legislation and expensive investment costs
- Regulatory requirements for transport and waste management increase admin burden
- Absence of secondary raw material market

Public sector:

- Lack of initiative in private sector (as a consequence, public sector is not aware of SMEs' needs and opportunities)

- Lack of capability affect the budget

- Very few direct funding instruments for IS and CE

Investors and banks

- low level of respond
- lack of knowledge about IS and CE
- lack of tailor-made funding instruments to support cooperation

External

Opportunities

Companies:

- Plans to invest in IS projects in the next 5 years
- A lot of potential in underutilized resources (waste, side streams, unutilized premises)
- Strong interest on the SMEs side to cooperate in the field of waste and by-product exchange

Public sector:

- There already is many cases of IS financing → with good promoting such cases can increase

Investors and banks:

- low level of knowledge gives an opportunity to start fresh

- More financing means more recognisability
- Co-operation with the three stakeholder groups with a committed leader, clear responsibilities and aim
- Create incentives to start investments (EU funding promoting, local financing)

Minimise internal problems by taking advantage of opportunities:

- Utilize the good cases in raising awareness
- Arrange education and training activities for employees, middle management and top management

Threats

Companies:

- Not willing to take the first step and risk to start co-operation (fear of short-term profit losses)
- willingness to invest sensitive to the regulatory framework: landfill taxes, end-of-waste criteria; standardize
- Secondary raw material markets are rare, poorly regulated and those existing highly volatile and still dependent on primary

Maximise strengths to minimise threats:

- Utilize good cases in advancing confidence in starting up new industrial symbiosis activities
- Name clear responsibilities among the co-operation organisations

Minimise and prepare. Use strengths to overcome:

- cost and payback times depending on the access to the market of secondary raw materials
- Legal status of the secondary raw material has a significant effect on the market price

material markets

Public sector:

- Not enough knowledge to know all the ways the public sector can contribute towards giving finance to IS
- Staff in public sector does not have appropriate knowledge in order to create a supportive environment for development of CE and IS

Investors and banks:

- level of knowledge does not rise

Figure 15. The 8-fold SWOT matrix combining the survey results from all partners

In most of the cases reported in the survey, the industrial symbiosis is about the exchange of materials and especially waste. The variation between whether the material is biological or technical is distributed quite evenly. The reported investment information varied from zero to millions of euros with the payback time of one and a half years to ten years. The most common investment information varied from 10.000 to 500.000 euros with the payback time of 2-5 years. Different EU-financing mechanisms play a fundamental role in funding industrial symbiosis and circular economy projects.

Most of the results of the survey came from companies. A strong willingness to participate to such projects is notable even though the lack of knowledge is still hindering the activity. In general based on the survey results many companies invest in industrial symbiosis at the SYMBI partners region especially in the field of sharing secondary resources. Based on the survey results, public body organisations can give finance to companies in certain conditions, which are determined by regional and national bureaucratic processes and financial status. More over public body organisations have other tools to direct companies to finance such as guiding them to specific EU-funding mechanisms and make the implementations of such

projects more feasible by example organizing events to raise awareness or through affecting (waste and secondary aggregate) legislation and directives. Based on the results the investors and banks have a general lack of knowledge about the two aspects and particularly lack of interest to participate in such surveys. However, many traditional investment tools can be used to finance industrial symbiosis and circular economy actions and to somewhat financing instruments tailored to specifically help cooperation between companies.

A general strength reported in most of the survey results is the added value that participating in industrial symbiosis brings. New business activities, products, brands and cooperation are the main drivers when implementing such projects. Savings and lowering environmental impacts through decreasing the amount of waste when it is utilized as material before entering the waste status also encourage taking part to such projects. Profits encourage investment.

Common weaknesses emerging from the survey results were the fear of taking the risk of forming partnership and starting cooperation and forming clear responsibilities between the organisations. Some companies also fear that if they fully depend on others' resources, they might not regularly get enough quantity and quality. This has to do with the price volatility and the absence of guarantees that by-products and secondary raw materials can be constantly available and provided. Factors hindering participations and investment were the high initial investment cost, technical and administrative barriers. The probability to participate depends largely of the availability of incentives and legal and bureaucratic possibilities.

A general threat is the rigidity of financial instruments. As for the time being, there is a lack of innovative funding and financial mechanisms that would allow companies (especially SMEs) to get fresh capital for investments in industrial symbiosis and circular economy projects. One of the reasons why such situation is, that industrial symbiosis and circular economy projects are relatively new, while the investment sector (particularly banks) need time to adopt to new realities. Another general threat is that if the level of knowledge does

not rise the situation might not advance. On the other hand, the level of knowledge acts as an opportunity as by increasing it in any of the three categories it might have a positive effect to the other. Companies seeking funding for industrial symbiosis and circular economy projects give the investment sector encouragement to create instruments tailored to such action and the availability of funding encourages companies to get involved. The general interest towards such activities gives the public sector regional development possibilities.

In most cases there are still more weaknesses than any other three features of SWOT analysis. The greatest opportunity is to overcome weaknesses and manage threats. All of the weaknesses can be tackled with information and raising awareness campaigns, promotion activities, sharing good practices, easing the bureaucratic barriers with legislation and taxation medications (e. g. new financial mechanisms, innovative approaches, new collaborative frameworks etc.) and targeted dissemination actions through different channels suited for specific target groups.