SYMBI
Interreg Europe

European Union
European Regional
Development Fund

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Joint study on COVID-19 impact, challenges and new industrial symbiosis opportunities

SYMBI Activity 2

Developed by Municipality of Kozani

Interreg Europe
European Union | European Regional Development Fund

Contents

Executive summary

SYMBI activity 2 prescribes a joint study to assess the impact of COVID-19 on industrial symbiosis (IS) practices in the partnership territories. In the course of activity 2, partners a) identified disruptions in industry, manufacturing and waste management businesses, as well as successful industrial symbiosis practices, and b) explored opportunities to facilitate the economic recovery and resilience through IS practices.

The core part of Activity 2 is the survey conducted by all participating partners, aiming to collect data regarding the impact of COVID-19 on IS in partnership regions. The first part of the Activity was focused on providing the methodologies to guide the survey; to that end, two methodology reports, including guidelines and questionnaires for data collection, were provided to SYMBI partners, the first by Kozani and the second by FUNDECYT. Subsequently, during the second part of the Activity, the questionnaires (filled in by partners and stakeholders) were sent back to the activity leader (i.e., Municipality of Kozani) to analyze the collected data and draft the summary report.

The current document is the final part of the Activity (i.e., the delivery of the joint study), aiming to present and summarize the key findings of the two questionnaires and make policy suggestions. In particular, it contains:

- A short overview of the SYMBI project and Activity 2 (Section 1);
- Thematic information on the impact of COVID-19 on rural regions and rural SMEs in particular (Section 2);
- The presentation and analysis of the survey's results from the two questionnaires, along with conclusions and policy suggestions (Section 3& 4).

1. INTRODUCTION

1.1 Overview of the 5th call of the SYMBI project

The "Industrial Symbiosis for Regional Sustainable Growth and a Resource Efficient Circular Economy – SYMBI" project seeks to "improve the implementation of regional development policies and programmes related to the promotion and dissemination of Industrial Symbiosis and Circular Economy[1]" in the partnership regions.

During its original duration – April, 1st 2016 until March, 31st 2021 – SYMBI project supported partners to exchange relevant good practices and lessons learnt, improve relevant policy instruments and action plans as well as develop synergies. However, the COVID-19 pandemic induced disruptions to industrial symbiosis practices; securing by any means the production and the operation of the territorial supply chains has come at the expense of sustainability and circularity. In the context of the 5th call of Interreg Europe, additional funding was provided to the partnership to cover 2 more semesters of activities. This project extension aims to support partners in identifying and mitigating the COVID-19 impact on their regional industrial symbiosis practices as well as exploring pathways to use industrial symbiosis to promote the recovery and resilience of the regional economies in the partnership regions. The duration of these additional activities lasts from October, 1st 2021 to September, 31st 2022 – in case further time is required, activities can be concluded until December, 31st 2022.

1.2 The SYMBI partnership

The SYMBI project brings together 9 partners from 7 countries. The members of the partnership are shown in the Table below:

Table 1: The SYMBI partnership

Country	*Partner*	*Region*
	**Foundation FUNDECYT Scientific and Technological Park of Extremadura**	Extremadura
	**The Malopolska Region**	Lesser Poland
	**Chamber of Commerce of Molise**	Molise
	**Government Office for Development and European Cohesion Policy**	Western Slovenia
	**Municipality of Kozani, Development and Planning Bureau**	Western Macedonia

[1] https://www.interregeurope.eu/symbi/

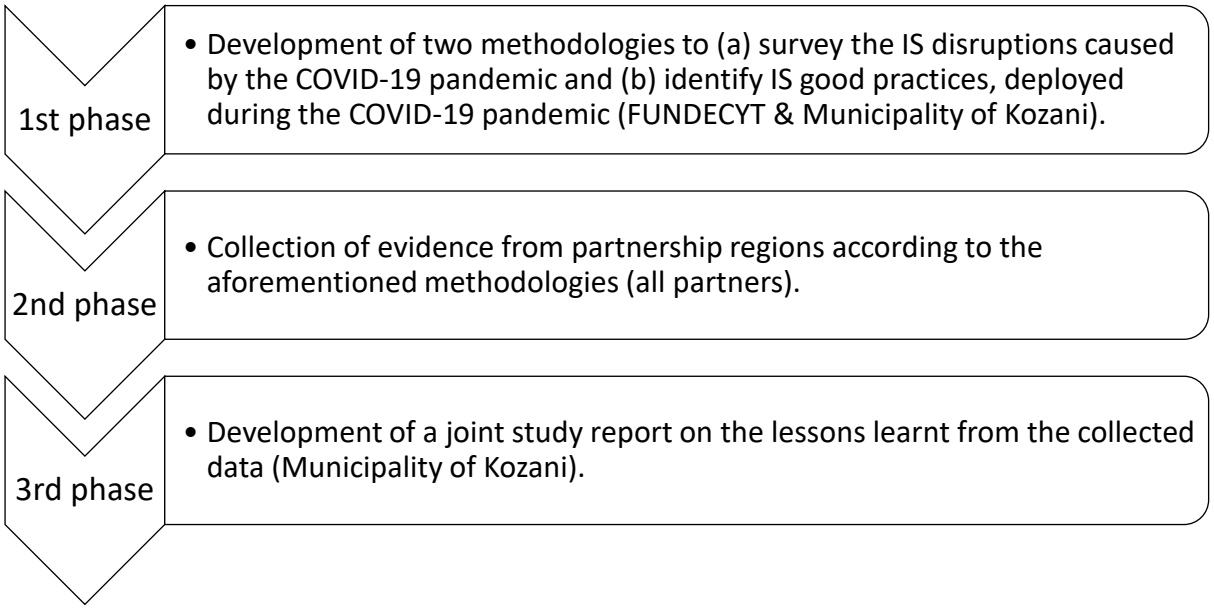
Country	*Partner*	*Region*
	**Pannon Novum West-Transdanubian Regional Innovation Non-Profit Ltd**	Western Transdanubia
	**Regional Council of Häme**	Southern Finland
	**Häme University of Applied Sciences Ltd**	Southern Finland
	**Regional Development Agency of the Ljubljana Urban Region**	Central Slovenia

1.3 Overview of Activity 2

Activity 2 is a joint study, titled "COVID-19 impact, challenges and new industrial symbiosis opportunities". Its goal is to identify disruptions in industry, manufacturing and waste management businesses as a result of the pandemic, share best industrial symbiosis practices in the partnership regions and explore opportunities to bolster the economic recovery and resilience of SYMBI regions through industrial symbiosis practices. The joint study is prepared based on the data collected by SYMBI partners and relevant stakeholders (i.e. employees, business/organization managers/owners, researchers).

As indicated in the following figure, Activity 2 consisted of the following phases:

- The first phase of Activity 2 concerns the provision of two survey methodologies to guide partners through the data collection process. These methodologies were prepared and provided to the partnership by FUNDECYT and Municipality of Kozani. The former concerned the identification of COVID-19 impact on industrial symbiosis practices in the SYMBI regions and utilizing industrial symbiosis practices and promote economic recovery and augment the resilience of regional economies to external events. The latter concerned the identification of good/best industrial symbiosis practices during the pandemic, which could serve as examples and aid future policy making.
- During the second phase, all partners have conducted the necessary research and provided the collected data to the Municipality of Kozani that is responsible for preparing this final report of the Activity 2.
- The third and final phase consisted the preparation of the final report, summarizing the key findings of the survey to draw conclusions and make policy suggestions on how regional authorities can support industrial symbiosis practices and utilize them to promote economic recovery and resilience.


1st phase
• Development of two methodologies to (a) survey the IS disruptions caused by the COVID-19 pandemic and (b) identify IS good practices, deployed during the COVID-19 pandemic (FUNDECYT & Municipality of Kozani).
2nd phase
• Collection of evidence from partnership regions according to the aforementioned methodologies (all partners).
3rd phase
• Development of a joint study report on the lessons learnt from the collected data (Municipality of Kozani).

2. THEMATIC BACKGROUND

2.1 Introduction

The outbreak of the pandemic has caused significant disruptions in the global economy and supply chains. Governments have been forced to implement lengthy country-wide lockdowns or other restrictions in an attempt to curtail the spread of the virus. This has led to a significant drop in the demand for most goods, either as a direct result of these measures or due to the increased economic uncertainty and the deteriorating economic climate. Consequently, the impact of COVID-19 on the economies has been wide-ranging, encompassing most of the major economic sectors.

With regards to the EU, the pandemic has led its economy to plunge into a severe recession registering a 6.1% GDP contraction, while the unemployment rate increased to 7.1%. At the same time, there has been an adverse impact on most supply chains, with international ones facing the greatest challenges due to export bans and the limitations in international travel. For example, several countries imposed export bans or restrictions on medical supplies related to the fight against the pandemic. On a similar note, the agriculture sector, which is highly reliant on seasonal, often migrant labor, faced significant challenges due to the travel restrictions that required ad hoc measures from the governments in order to ensure the uninhibited continuation of agricultural activities.

Naturally, the disruptions to the fundamental economic activities are bound to have an adverse impact on synergetic and cooperative economic activities that encompass multiple supply chains. In that respect, circular economy is also expected to be negatively impacted by the pandemic.

2.2 Disruptions on industrial symbiosis practices, caused by COVID-19

Although the introduction of Industrial Symbiosis (IS) practices is expected to increase the resilience of the economy to external events (e.g., health crises, climate change, shocks in the supply / demand due to geopolitical developments), the latter will still have an impact on the economy nonetheless. In addition, the relative insignificance and immaturity – at least currently – of the circular economy compared to the conventional, linear economic model increases the vulnerability of IS practices and initiatives as they are embedded in an overwhelmingly linear economic structure, thereby sharing, necessarily, its vulnerabilities to external events. As a result, IS practices have also been impacted by the outbreak of the pandemic and the ensuing economic crisis. The current section focuses on disruptions on circular economy, in general, as the latter has been extensively explored with regards to the pandemic. A number of disruptions are presented below:

2.2.1 Disruptions in social interactions among supply chain business partners

Studies have reported a more limited scope of social interactions among supply chain partners during the pandemic, which has not only caused information incompleteness but has also reduced supplier engagement, making it harder for the companies to develop a collaborative approach that builds synergies with other relevant actors. Although established cooperation initiatives that incorporate circular economy practices might not have been particularly impacted by this development, the

restrictions in social interactions could have negatively impacted the development and realization of new industrial collaborations and cooperation initiatives.

2.2.2 Changes in public procurement priorities

Public procurement is expected to provide the necessary impetus for the transition to a circular economy. However, during the pandemic there has been a shift in the priorities of public authorities in view of the severity of the crisis and the urgency of the procurement needs. In particular, there has been an emphasis on procuring goods fast and in the needed quantities, while environmental criteria have, to a large degree, been disregarded. This development has reduced the appeal of industrial symbiosis practices, since circular value chains have typically a lower environmental footprint compared to linear ones.

2.2.3 Regulatory changes

Beyond the changes in public procurement priorities, there were also COVID-induced changes in regulations that favored the current linear economic models and discouraged the adoption and implementation of circular economy practices. As an example, the compulsory use of single-use plastics in the hospitality industry has directly impaired the progress towards reusable items. Similar regulation changes due to safety protocols can have a considerable impact on the demand for circular products, discouraging further investment in the circular economy.

2.2.4 Changes in the private sector priorities

The willingness of businesses to adopt circular practices has waned during the pandemic, as lots of them have been adversely impacted by the economic crisis and are lacking the financial resources to invest in circular products / services. As an example, in a study among tourism experts, a number of them mentioned that the sustainability positions were the first to be cut due to the economic hurdles that the companies faced during the pandemic. In turn, this loss of valuable expertise is expected to significantly curtail the ability of these businesses to identify and implement circular economy concepts, thus, reducing the overall demand for circular products / services.

2.2.5 New types of waste

Finally, the outbreak of COVID-19 has given rise to types of waste that are new for most businesses (e.g., sanitizer gels, gloves, disposable masks), which lack the experience and the expertise to dispose them in a sustainable way. In turn, this further reduces the circularity of the economy and poses new challenges to all the relevant actors. In a similar vein, certain types of waste are not suitable for recycling due to safety protocols. For example, the recycling of medical waste, which increased by 65% during the pandemic, is not allowed e.g. in Flanders. Instead, the waste is sent for decontamination or incineration.

2.3 Post-COVID economic recovery: Utilizing circular economy and IS to increase the resilience of the economy

The resilience of the European economy to external events came into question during the pandemic. The disruptions in the global and European supply chains have made it conspicuous that there is a need to shield the EU economy by increasing its resilience and ability to mitigate the impact of external

events on the European and national value chains. This need is further amplified by climate change and the various geopolitical risks, as is the case with the Russian invasion in Ukraine. Consequently, the European societies are required to explore all avenues to increase the resilience of their economies in the coming years.

In general, several relevant studies agree that the economic resilience to external shocks is related to the following attributes of the economy:

- The ability of the economy to avoid the shock.
- The ability of the economy to mitigate the impact of the shock.
- The ability of the economy to swiftly recover from the shock.

In the current conjunction, circular economy and industrial symbiosis in particular are expected to play a key role in reshaping the value chains and building up the resilience of the economy, as they offer considerable advantages. In particular, the synergies developed through the establishment of IS schemes are expected to provide financial benefits to the participating businesses and the local communities, thus, contributing to a swifter and more effective recovery. At the same time, the reduced ecological footprint, intrinsic to circular economic models and practices, is expected to contribute to the longevity, economic and environmental, of the economic recovery. From the IS practices that have been successfully implemented during the COVID-19 crisis (mentioned above), several important aspects emerged as essential in mitigating the impact of external events, like the current COVID-19 pandemic. In that respect, it is important to orient the recovery efforts towards a direction that enhances their presence in the economy as well as the robustness of the synergies. Some indicative areas, where the employment of circular economy practices, like industrial symbiosis, are beneficial are the following:

2.3.1 Diversity in the supply chain

This refers to the necessity of having multiple supply sources to avoid bottlenecks and, consequently, increase the stability and sustainability of the system since the loss of a link in the supply chain can be replaced. This is particularly important in the case of circular economy due to the interdependence of the relevant actors.

2.3.2 Supply chain agility

This concept refers to the ability of an entity, a business or an integrated network of organizations, to quickly adapt to changes in the economic environment and adjust or shift its activities based on the economic environment. Ensuring that the entire supply chain has the necessary agility to adapt to changing situations and meet new challenges has obvious advantages in terms of sustainability and ability to alleviate the impact of unexpected external events.

2.3.3 Localization strategies and shorter supply chains

The implementation of circular economy practices increases the cooperation between the various economic actors by incorporating them in a single supply chain. When these practices have a localized character, as in the case of IS, they lead to shorter supply chains, thus reducing the overall exposure of the economy to risks and crises affecting third countries. A corollary to this is the reduced dependency

on foreign sources for the supply of raw materials. The popularization of circular economy practices will increase the valorization of waste, providing alternative paths to obtain raw materials. This will curtail the dependence of EU on international supply sources and mitigate the impact of geopolitical risks and events on European value chains.

2.3.4 Increased cooperation between participating actors

Circular economy incorporates various economic actors into a value chain, developing synergies between them through a cooperative process that valorizes the waste produced in the previous stages of the value chain. Hence, circular economy, by definition, increases the cooperation between the various actors in the value chain. In turn, close cooperation between the primary actors of the value chain is expected to contribute to their ability to mitigate the impact of external events and disturbances in the world markets and, thus, increase the resilience of the economy.

Based on the above considerations, it becomes evident that i) there is a clear policy momentum towards “green”, climate-neutral solutions, and increasing the resilience of the economy ii) there is sufficient funding devoted to affecting an economic recovery from the pandemic-induced economic crisis and realizing changes of a fundamental nature to the EU economic model iii) introducing circular economy practices, such as IS, is essential in achieving those goals. Consequently, IS, along with other relevant practices within the context of a circular economy, should be viewed as an integral part of the post-COVID recovery.

3 ANALYSIS OF DATA ON GOOD PRACTICES

3.1 Survey objectives and target groups

The collection of the good practices by the partners was based on the methodology provided by the Municipality of Kozani. The purpose of the survey was to identify good industrial symbiosis practices which took place during the pandemic in the partnership territories, in order to augment the knowledge of regional authorities and increase their capacity to support and promote industrial symbiosis initiatives and utilize them to increase the recovery and resilience of regional economies.

The target group of the survey were businesses and organizations involved or participating in industrial symbiosis practices in the partnership countries. The criteria for the identification of good practices were provided in the corresponding methodology report. In particular, the good practices collected abide by the following criteria:

- Address a common problem or issue experienced by different organizations / contexts / regions / cities;
- Make an original contribution or offers a significant improvement to a shared problem compared to existing practices;
- Are proven successful by providing measurable or demonstrable results or by going through internal or external validation and evaluation;
- Can be effective in more than one organizational or regional settings; and
- Can be replicated, at least to some extent.

In addition, according to the provided methodology, of particular interest were cases that concerned (presented with descending importance):

- Industrial symbiosis examples directly contributing to the fight against the COVID-19 pandemic
- Industrial symbiosis examples taking place during the pandemic, even when not directly related to the fight against COVID-19.
- Older industrial symbiosis examples that the participating partners consider to still be relevant as tools towards economic recovery and resilience.

3.2 Survey statistics

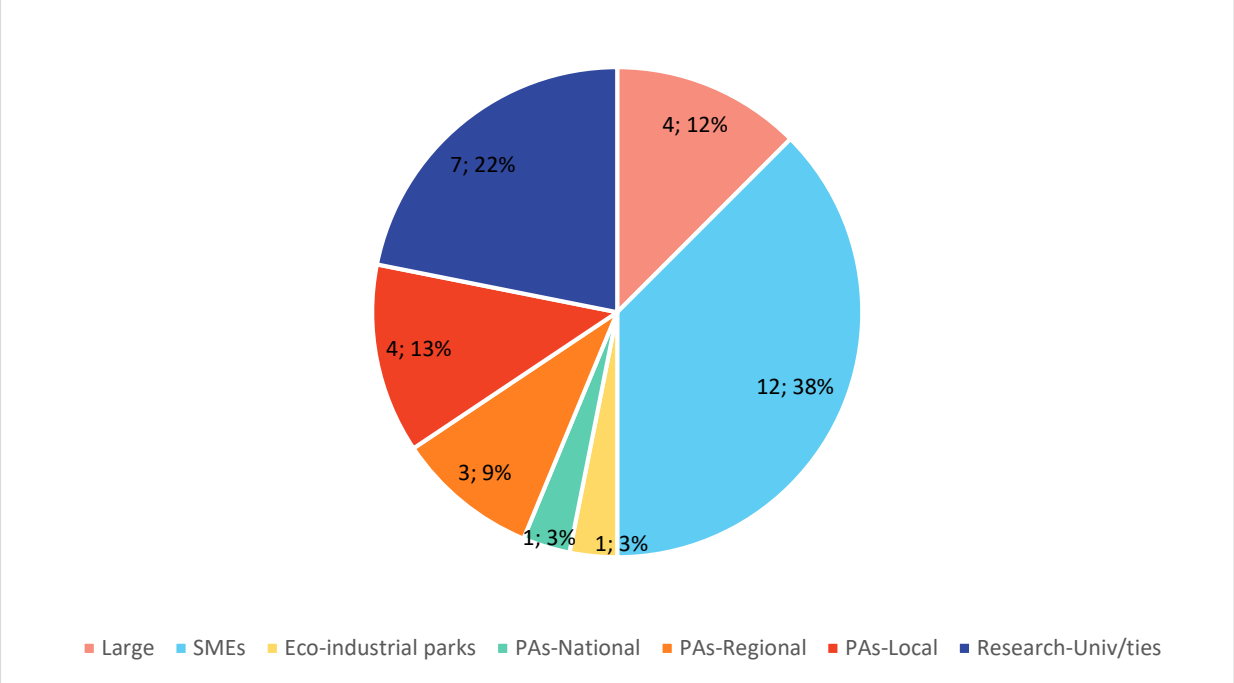
In total, SYMBI partners were able to identify 14 good practices of industrial symbiosis. In these initiatives, 32 organizations / businesses were involved. There was also an IS idea, therefore it is by default excluded from the analyzed data.

Table 2 – Overview of the IS practices collected

Respondent	*Good practice*	*Country*
INTROMAC	Reduce the content of heavy metals in the sludge from wastewater treatment plants, using the ash (production waste) to bind it.	ES
DREWNEX	Converting dry woodchips into pellets.	PL
OPAKOMET	Production of eco-friendly product with recycled plastic.	PL

Respondent	*Good practice*	*Country*
CENTRALLE DEL LATTE DEL MOLISE	The input is a by-product, (concentrated whey). The output is "permeate", a substance subsequently used to feed biogas plant.	IT
FIBRE SRL	Recycling plastics for the production of innovative textile fabrics.	IT
SMALIMENTI SUD SRL	Pushing, selection and recycling of plastics from waste for the production of innovative textile fabrics to be supplied to a clothing production company.	IT
FLOIOS	Handmade sustainable jewelry from recycled silver recovered from electronic waste.	SI
SMETUMET	Remake trash into a glamorous product.	SI
FOSDA WM	The Municipalities provide recyclable waste which is later processed and sold to industries for new use.	GR
ANAKEM	Utilization of construction waste for the production of cement and other construction materials.	GR
DUNA-DRAVA	Thermal recovery of industrial waste, offered as a "zero landfill" solution.	HU
KESKO	Coffee grounds generated at traffic stations are utilized in the production of gardening products – pilot scale	FI
HAME UAS	Exchange of secondary or waste materials.	FI
SOOS-ERNO	Water & waste-water treatment practices.	HU

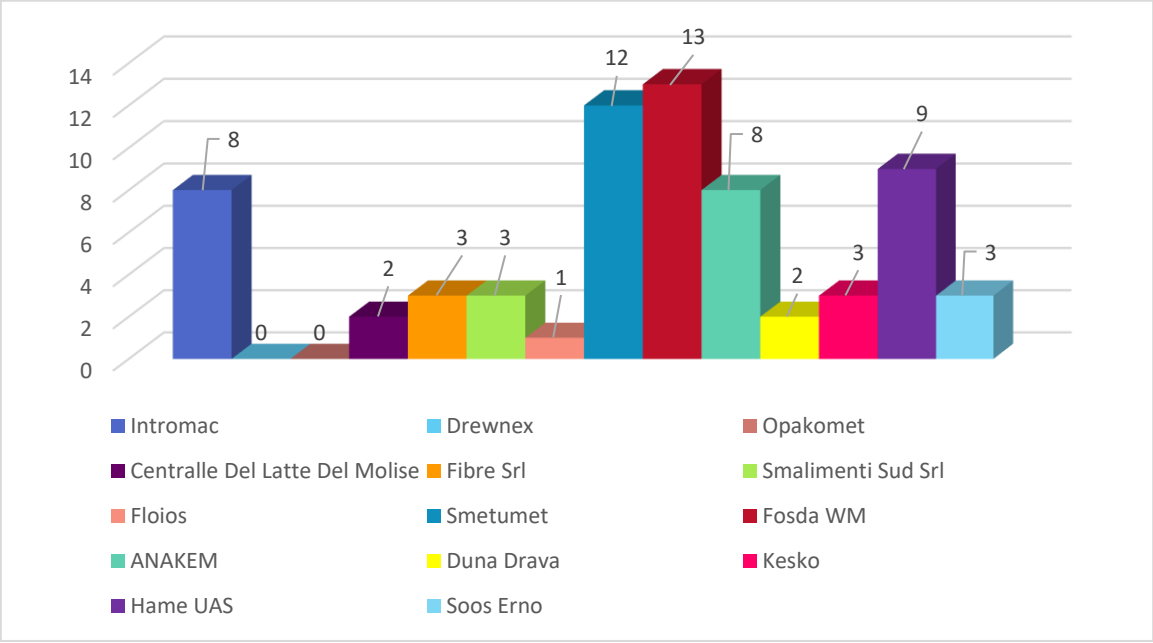
Graph 1 – Number of respondents per type of enterprise



A breakdown of the kind of participants is shown in Graph 1. SMEs constituted the largest segment of the participants, being involved in 12 out of the 14 good practices provided by partners whereas large enterprises were significantly less represented. This might be the result of a targeted survey distribution. On the other hand, it can be explained as the potential of small enterprises to adopt innovative approaches. Almost half of the cases involved technology producers / providers, highlighting the importance of these companies realizing industrial symbiosis. Each initiative can have more than one aspect; therefore, the overall sum is higher than the number of cases. It is not necessary to include more than one type of enterprise to have a successful symbiosis, e.g. industries using one's waste to feed the other's production. This depends on the nature of the symbiotic practice. Most certainly, public authorities' participation is not a prerequisite.

Graph 2 presents the number of participating organizations for each one of the industrial symbiosis initiatives. There are two cases (case No2 and No 3) that no specific number of participants is mentioned by respondents. Otherwise, most of the cases involved a relatively low number of participants (up to 3), indicating that complexity is not a requirement for implementing industrial symbiosis practices. Nevertheless, over a third of the cases involved 8 or more participants, showing that more complex and ambitious initiatives can also be successful.

Graph 2 – Number of participants in IS practices

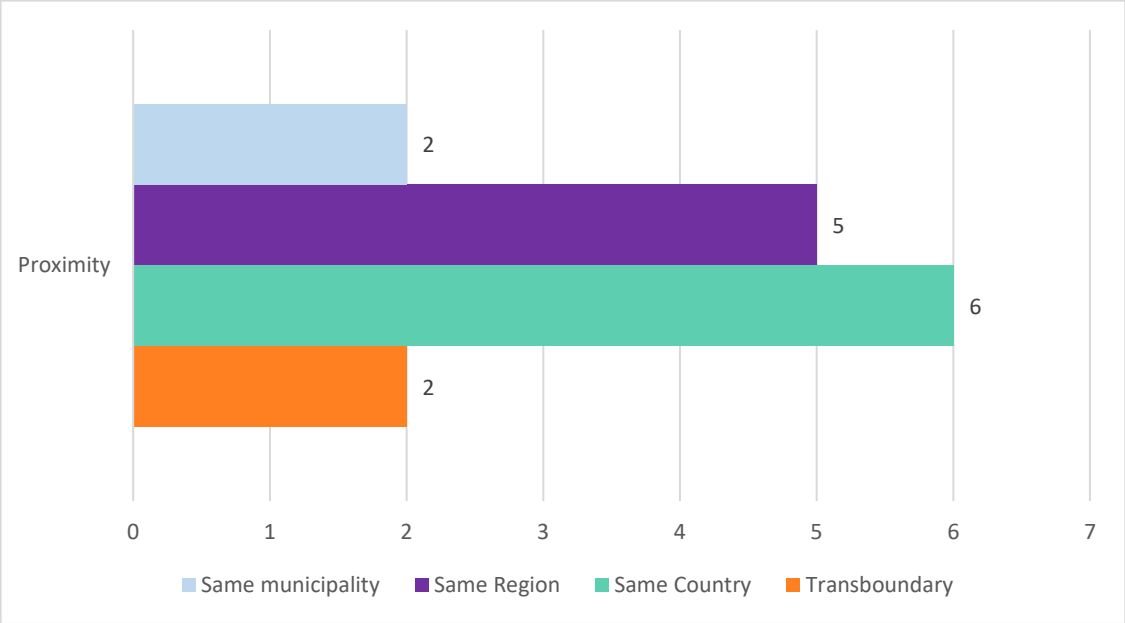


3.3 Characteristics of industrial symbiosis initiatives

This section presents some key characteristics of the provided industrial symbiosis initiatives. Identifying characteristics that most successful initiatives share will enable public authorities to more effectively implement policies that support and promote industrial symbiosis initiatives.

Graph 3 shows the geographic scale of the initiatives represented in the sample. In the vast majority of cases, the participants were located in the same country or region. Only in 2 cases the initiative entailed transboundary cooperation, indicating that, even within the EU, international cooperation in the context of industrial symbiosis is limited.

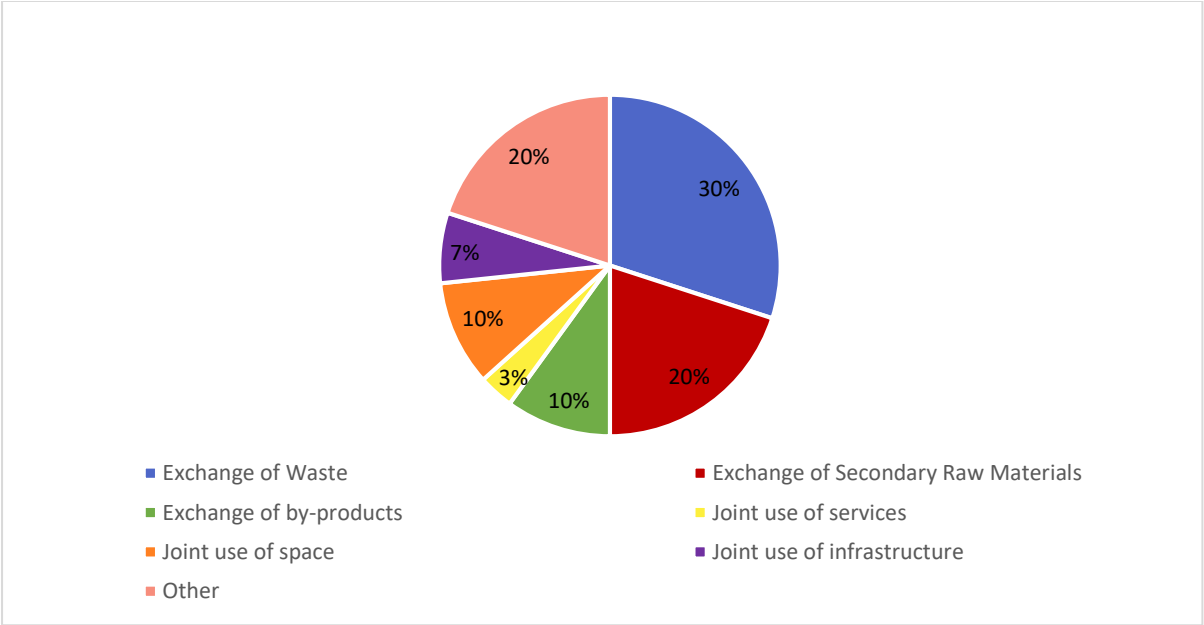
Graph 3 – Geographical proximity in IS schemes



In Graph 4, the initiatives have been categorized based on the type of symbiotic relationship that characterizes them. Each initiative can have more than one aspect; therefore, the overall sum is higher than the number of cases.

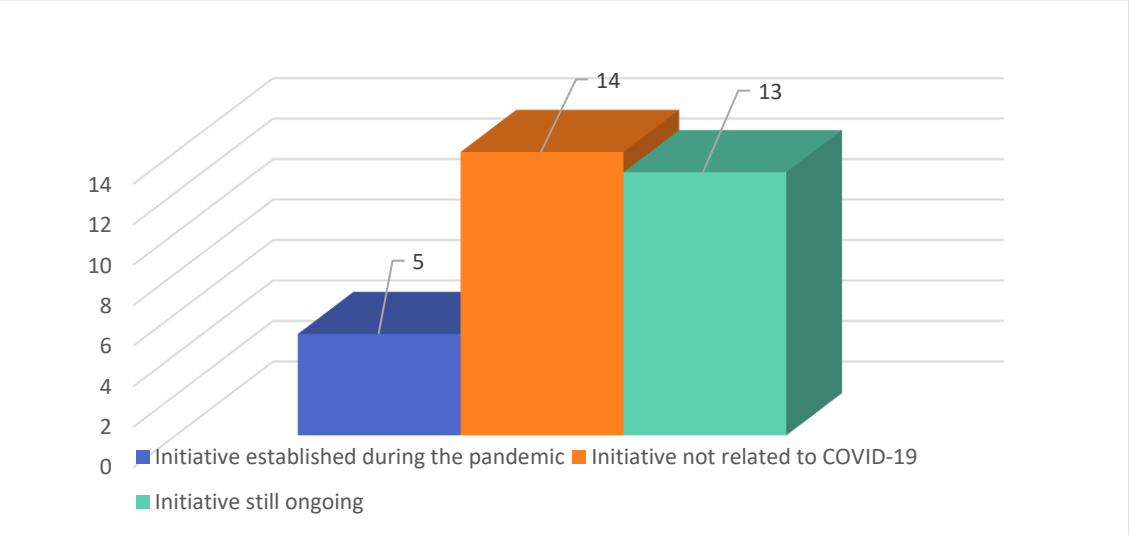
Exchange of waste is the most represented type of industrial symbiosis, being present in 9 out of the 14 cases collected. This is an expected result, since circular economy aspects, involving the valorization of waste, are essential in industrial symbiosis practices. Exchange of secondary raw materials, obtained through recycling of discarded products or other waste, is the second more often reported kind of relationship and is also related to the utilization of waste.

Graph 4 – Symbiotic relationship percentages



Partners have also reported on the time of establishment of the industrial symbiosis initiatives as well as whether they were implemented to address needs related to the pandemic (Graph 5).

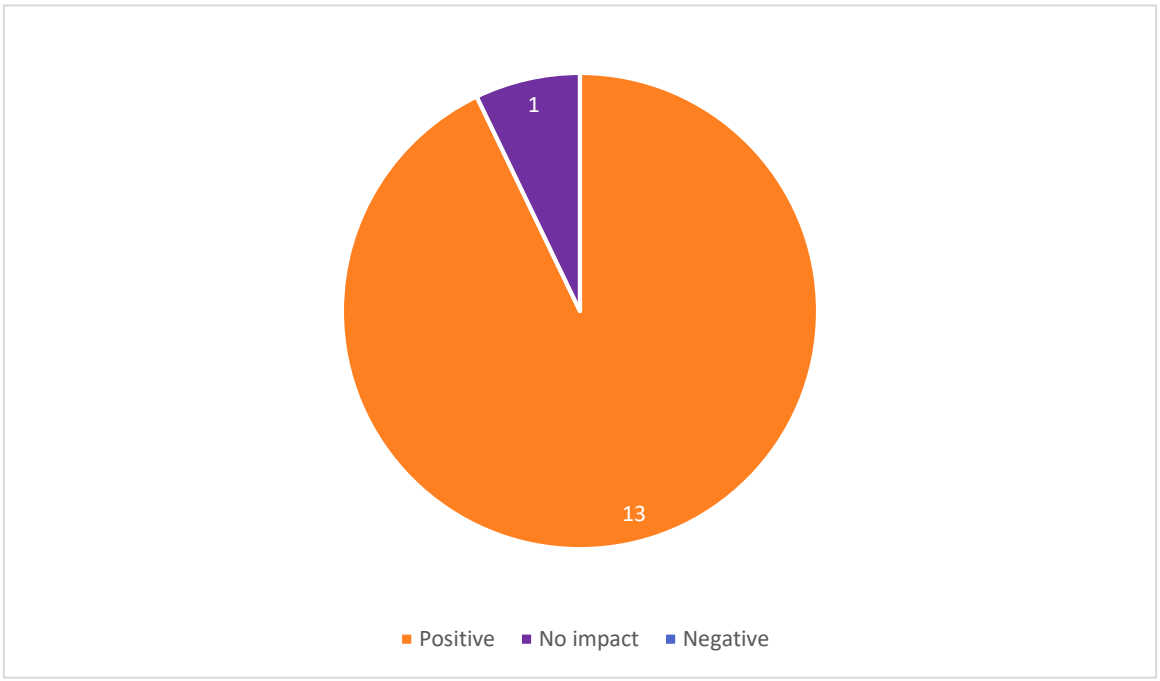
Graph 5 – Establishment of the industrial symbiosis percentages



In 5 cases the initiative was first implemented during the pandemic. However, in all 14 cases the initiative was not related to COVID-19, indicating either that industrial symbiosis was not viewed as necessary for the fight against COVID-19 or that there was not enough time to establish new industrial symbiosis schemes. At the same time, 13 of the presented industrial symbiosis initiatives are still ongoing, indicating their resilience to the crisis and the importance of the provided examples.

Finally, partners have reported on the overall economic impact of each industrial symbiosis initiative. The results are shown in Graph 6. The overwhelming majority of the respondents reports a positive economic impact, highlighting the economic appeal of industrial symbiosis and its potential to bolster the economic recovery from the COVID-19 crisis.

Graph 6 – Economic Impact factor of the symbiotic percentages

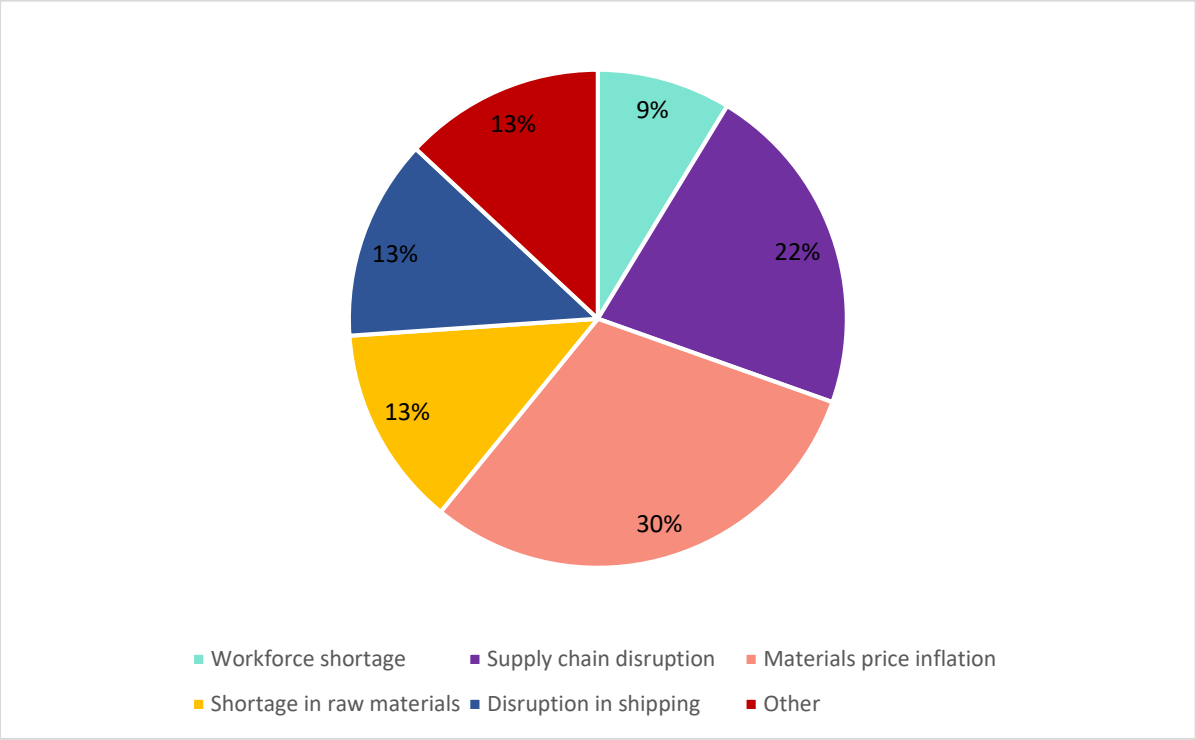


3.4 Impact of COVID-19 on industrial symbiosis initiatives

An important part of the survey concerned the impact of COVID-19 on the industrial symbiosis initiatives in the partnership regions and countries. Understanding the challenges that these initiatives encountered during the crisis and how they successfully addressed them is expected to improve regional policy making as it will enable regional authorities to more effectively support these initiatives in times of crisis.

Survey respondents have reported on the disruptions that industrial initiatives faced as a result of the pandemic. The results are summarized in Graph 7. Inflation of the prices of materials is the most often reported disruption that industrial symbiosis initiatives faced. This is not surprising, since the pandemic has caused major disruptions in the international markets, leading to considerable fluctuations in the prices of raw materials and products. Supply chain disruptions is the second most cited disruption. Again, this is expected due to various export bans, lockdowns, supply bottlenecks and changes in the demand of products, all of which contributed to the disruption of the pre-pandemic supply chains. Other reported COVID-19 related disruptions include shortages in the supply of labor and raw materials.

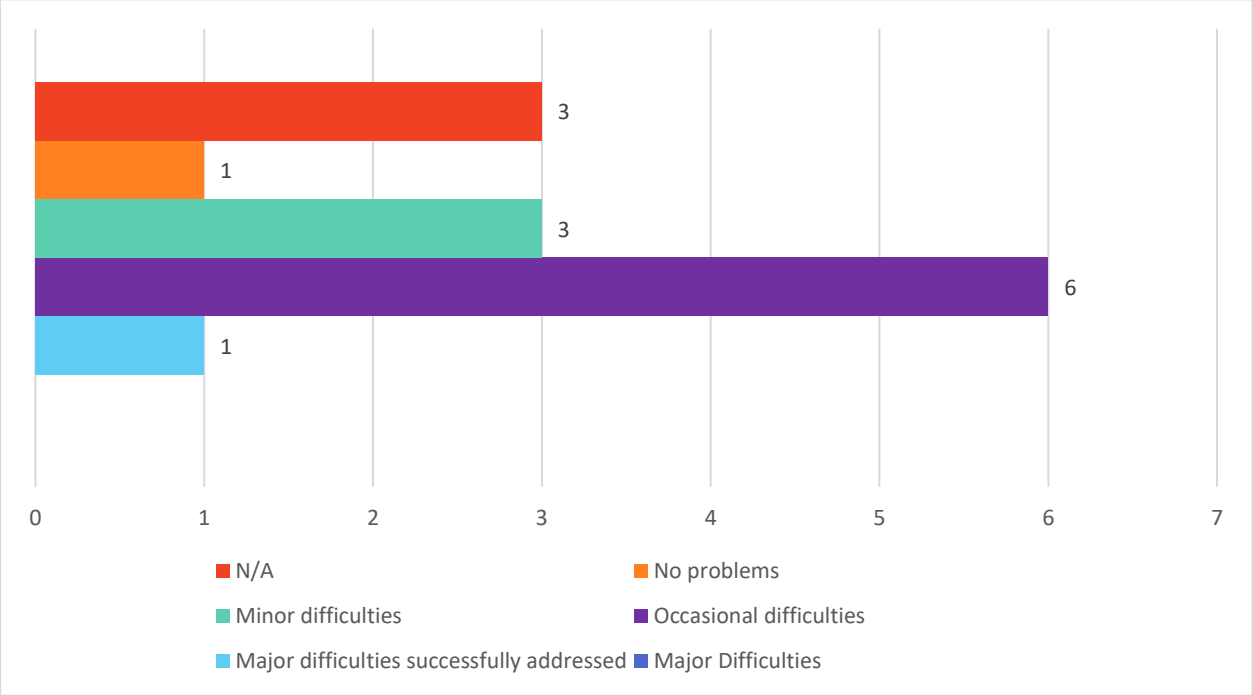
Graph 7 – Factors of Business disruptions



Survey respondents have also reported on the severity of the COVID-19 impact on industrial symbiosis initiatives in their regions and countries. Their findings have been summarized and presented in Graph 8. In 6 cases they reported that the initiatives occasionally encountered major difficulties during the pandemic, which however were addressed without creating further issues. In 3 cases the partners reported only minor difficulties during the pandemic, while in one case there were no disruptions in the implementation of the industrial symbiosis initiative. Finally, in one case there were major

difficulties encountered, which caused major issues until they were addressed. Overall, it appears that the impact of the pandemic on industrial symbiosis initiatives was moderate, with 4 initiatives reporting minor or no disruptions during the pandemic and a significant number of them encountering occasional major adversities, which however were addressed without any further impact. Given the overall severity of the impact of COVID-19 on EU economies, industrial symbiosis initiatives have shown a considerable resilience to the crisis, highlighting their potential for increasing the overall resilience of the economy.

Graph 8 – COVID-19 on industrial symbiosis initiatives



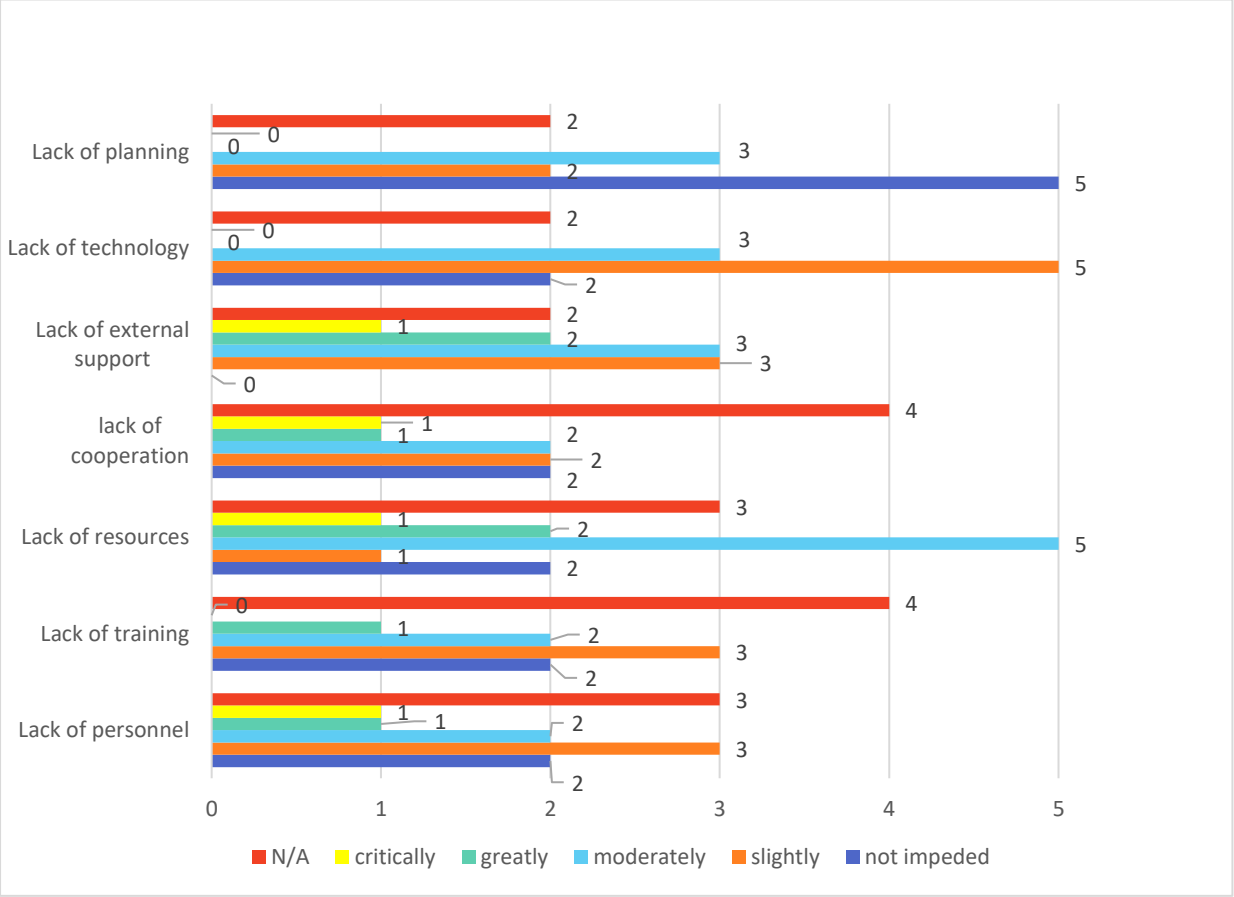
3.5 Enablers and inhibitors in the implementation of industrial symbiosis practices

A major part of the survey concerned the identification of enablers and inhibitors for the realization of industrial symbiosis initiatives. This has direct implications for future policy making, as regional authorities, through their policies, should seek to mitigate the impact of the inhibitors (or negate them altogether) and augment the impact of the enablers in order to support the existing initiatives and facilitate the realization of new ones.

Respondents first reported on general issues that industrial symbiosis initiatives face and have an adverse impact on their operations. The results are presented in Graph 9. Based on the collected data, the most important inhibiting factors were the lack of external support (e.g. economic support) and the lack of resources. The former (lack of external support) is something directly impacted by the policies of public authorities and is an area that regional policy implementation could further improve. Other major inhibitors, reported by the partners, were the lack of appropriately trained personnel and the lack of cooperation between businesses. In this case also, public authorities could foster the smooth

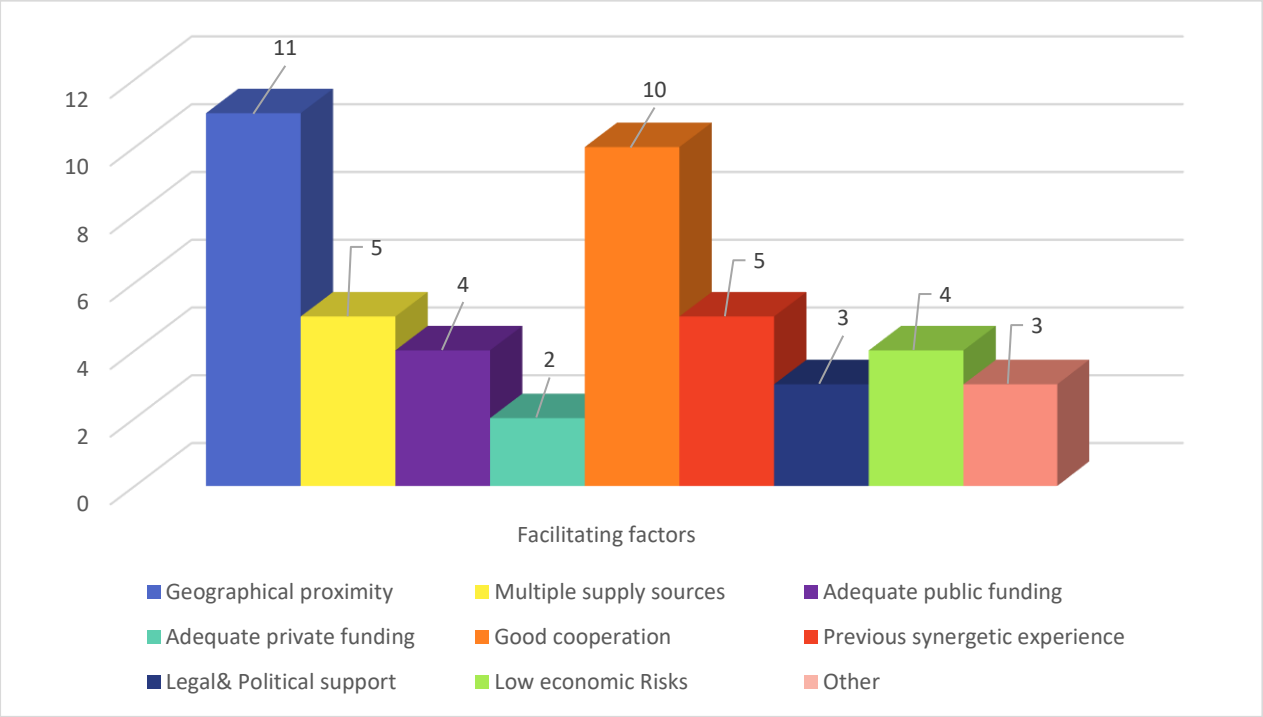
implementation of industrial symbiosis initiatives through suitable training programs and facilitating the cooperation between research / education organizations and the industry.

Graph 9 – Challenges which impeded the implementation of symbiotic symbiosis



Survey respondents have also reported on the major enablers, factors that facilitate the smooth operation of industrial symbiosis initiatives and augment their impact and effectiveness. The results are summarized in Graph 10. Each initiative can have more than one aspect; therefore, the overall sum is higher than the number of cases.

Graph 10 – Factors facilitating the successful implementation



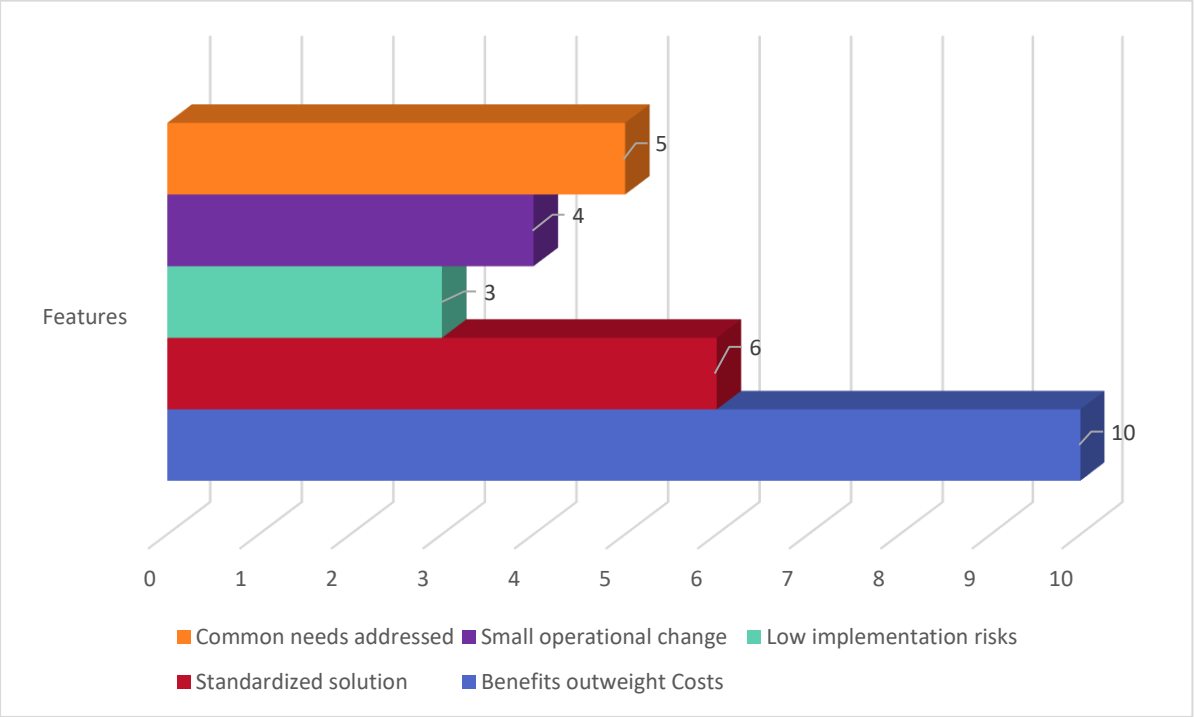
Geographical proximity is the most often cited factor, a result that is not surprising since it facilitates closer cooperation and leads to reduced transportation costs. The second most often reported factor is the good cooperation between businesses, a result that is in alignment with the results of the previous graph, showing the lack of cooperation between businesses as one of the major inhibiting factors. Other factors mentioned by the partners are adequate private and public funding, obtaining multiple supply sources, previous experience in similar initiatives and political and legal support. These results provide a basis for the improvement of future policy making, either directly supporting industrial symbiosis initiatives (e.g. through financial incentives) or by using these results to create a more nurturing policy and economic framework, which will facilitate the increased adoption of industrial symbiosis practices.

3.6 Transferability of industrial symbiosis good practices

In the final segment of the questionnaire, the partners commented on the transferability of the provided good practices. Given the focus of Interreg Europe on interregional cooperation, evaluating the transferability of these practices is of critical importance, as it is directly related to the applicability of these practices in different situations and regions, thus directly influencing policy making in this area.

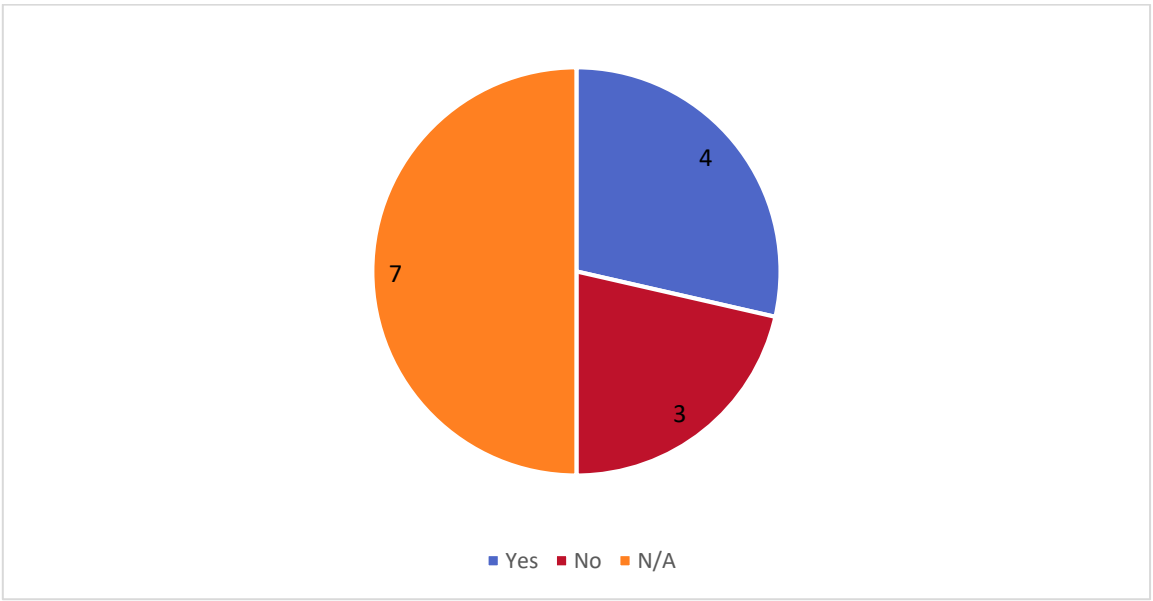
Partners have first commented on characteristics of industrial symbiosis initiatives that increase their transferability potential. The results are summarized in Graph 11. Each initiative can have more than one aspect; therefore, the overall sum maybe higher than the number of cases.

Graph 11 – Features ensuring the practice's transferability



Not surprising, the most often cited factor is the economic appeal, i.e. the expected benefits exceeding the expected costs. It clearly shows that the further proliferation of industrial symbiosis practices can only happen on the basis of a tangible economic advantage. Future policy making in this area could thus focus on improving the economic appeal of industrial symbiosis through financial incentives, better implementation of green public procurement or other measures. Beyond that, the use of a well-established technological solution and practices along with addressing needs that are common among industries / organizations in different regions are also viewed as important factors in determining the transferability potential of industrial symbiosis practices.

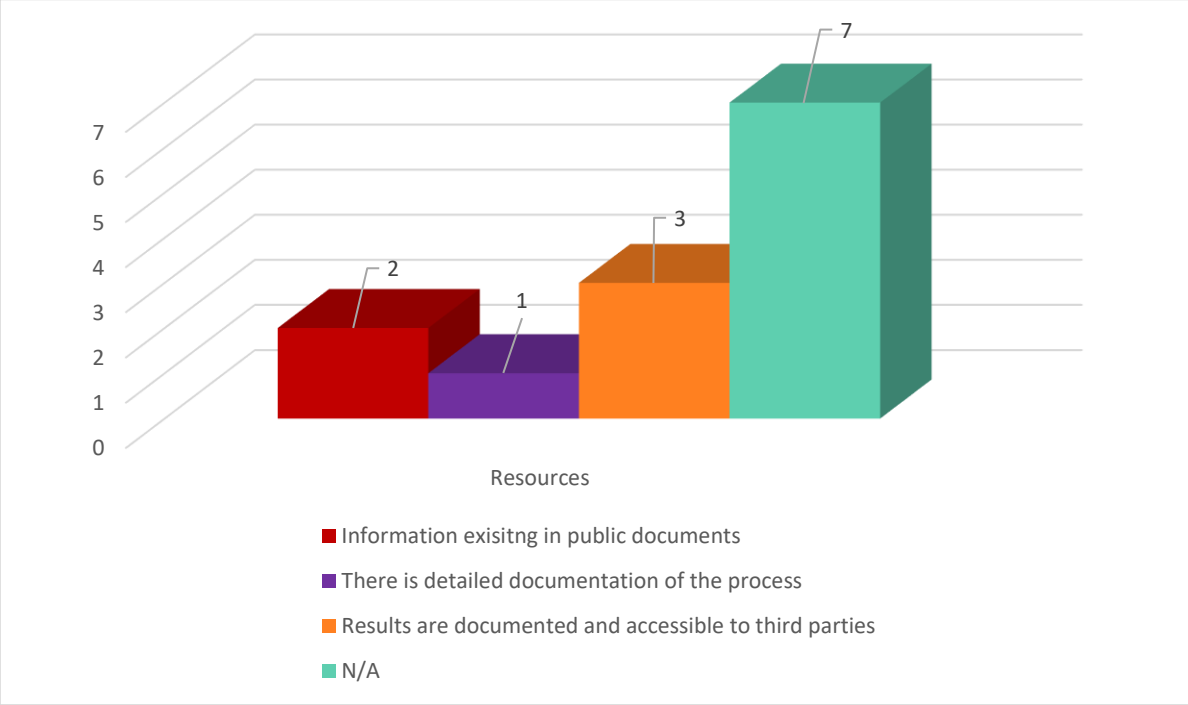
Graph 12 – Transfer of the industrial symbiosis practice to other regions



Subsequently, the partners commented on whether the industrial symbiotic practices have been transferred to other regions. The results are presented in Graph 12. In 4 cases there was a transfer of the practices to a different region, showcasing the transferability potential of these practices. Nevertheless, in half of the provided cases there was no information on this, which puts a limit on the conclusions that can be derived from the survey on this matter.

Finally, the collected data provided information on the availability of resources that will aid third parties in implementing the presented good practices. The availability of these resources increases the transferability of the industrial symbiosis practice and is a feature that should be adopted by all related initiatives. The results of the survey are shown in Graph 13.

Graph 13 – Resources available to facilitate the transfer of the symbiotic practice



In more than half of the cases there was no information provided, potentially signifying the need for further improvement in this area. From the industrial symbiosis initiatives that confirmed the existence of these resources, 3 reported that there are some documents that are available to third parties, who seek to adopt the industrial symbiosis practice, 2 reported that information is in public documents and in one case there is a detailed documentation of the implementation process. Overall, the results show an effort to increase the transferability of the implemented practices, however further improvements are required.

3.7 Evaluation of good practices

3.7.1 Criteria

Data in the form of a questionnaire were collected from businesses and organizations that are involved in the implementation of IS practices in the partnership regions. After the collection of data by project partners, all cases were evaluated by the Municipality of Kozani, based on the evaluation cited in ANNEX 2. The Municipality of Kozani used the following criteria in order to evaluate and classify the data collected:

- Relevance & effectiveness: This criterion aims in detecting to what extent the symbiotic practice can potentially address the COVID-19-induced business disruptions that have been identified by partners experience and research.

- Implementation: This criterion aims to assess the implementation process of the symbiotic practice. It will, thus, document to what extent it has met its implementation expectations and the level of difficulty when implementing it, in terms of the average implementation difficulty. It, also, aims to identify the enablers that ensured its successful implementation as well as the barriers that hindered it.

- Transferability: This criterion evaluates the transferability of the symbiotic practice. More specifically, it aims to identify the most significant features that make the industrial eco-system transferable as well as the potential for replicability to new geographical contexts – namely, to what extent the implementation process has been documented and is accessible to the public as well as if it has already been transferred to new settings.

- Robustness: This criterion assesses the robustness of the symbiotic practice. In other words, it aims to evaluate the IS network's flexibility in terms of the types of the involved actors, their geographical proximity as well as the types of symbiotic relationship between the participating businesses.

3.7.2 Evaluation process and results

In total, the maximum evaluation score for a case is 52 points.

Each section has a weighting factor, depending on the importance of each concept explored, and based on existing literature.

- Sections B.3, B.4, C.1, C.2, C.4, and C.5 have 1 as the weighting factor.
- Sections C.6, C.7 and C.8 have 2 as the weighting factor, so the final sum will be doubled.
- Finally, attention should be attributed to C.3 section, which has -1 as weighting factor, so the corresponding points will be cut from the final sum.

Table 3 – Evaluation results and final score of the IS practices

Evaluation score	*Respondent*	*Good practice*	*Country*
15.75	INTROMAC	Reduce the content of heavy metals in the sludge from wastewater treatment plants, using the ash (production waste) to bind it.	ES
16	DREWNEX	Converting dry woodchips into pellets.	PL
11.5	OPAKOMET	Production of eco-friendly product with recycled plastic.	PL
13	CENTRALLE DEL LATTE DEL MOLISE	The input is a by-product, (concentrated whey). The output is "permeate", a substance subsequently used to feed biogas plant.	IT
12.75	FIBRE SRL	Recycling plastics for the production of innovative textile fabrics.	IT

Evaluation score	*Respondent*	*Good practice*	*Country*
11.75	SMALIMENTI SUD SRL	Pushing, selection and recycling of plastics from waste for the production of innovative textile fabrics to be supplied to a clothing production company.	IT
12	FLOIOS	Handmade sustainable jewelry from recycled silver recovered from electronic waste.	SI
15.25	SMETUMET	Remake trash into a glamorous product.	SI
31.5	FOSDA WM	The Municipalities provide recyclable waste which is later processed and sold to industries for new use.	GR
26	ANAKEM	Utilization of construction waste for the production of cement and other construction materials.	GR
16.25	DUNA-PRAVA	Thermal recovery of industrial waste, offered as a "zero landfill" solution.	HU
24.75	KESKO	Coffee grounds generated at traffic stations are utilized in the production of gardening products – pilot scale	FI
19	HAMEUAS	Exchange of secondary or waste materials.	FI
16.75	SOOS-ERNO	Water & waste-water treatment practices.	HU

The most successful symbiotic practice, according to the evaluation, is the synergy of the Municipalities of Western Macedonia (GR), where the recycled material from municipal waste is sold to industries. The next highest score concerns the practice mentioned by ANAKEM (GR), where all construction and demolition producers and waste management businesses deposit their waste in the same quarry for landfilling. The 3rd highest score comes from KESKO (FI), where coffee stations gather their waste coffee grounds to be used in the production of gardening products (growing peat).

The high score comes mainly from the transfer of the practice to other territories.

3.8 Conclusions

The results of the survey contain valuable information for policy makers, who seek to promote industrial symbiosis practices in their regions. In particular, information on the characteristics shared by the best relevant practices will help public authorities identify the key policy areas that will facilitate the further proliferation of industrial symbiosis initiatives.

The first remark concerns the impact of COVID-19 on industrial symbiosis practices and initiatives. The impact of the pandemic appears to be moderate, with only one initiative experiencing major difficulties related to the pandemic. This result highlights the resilience of the industrial symbiosis initiatives to the COVID-19 crisis and underscores their usefulness in increasing the overall resilience of the EU economies. As a result, policy makers seeking to bolster the resilience of the regional economies to external events should explore ways to promote the adoption of industrial symbiosis practices.

A major result of the survey concerned the identification of enablers and inhibitors for the implementation of industrial symbiosis practices. These results have direct implications for policy makers who aim to promote industrial symbiosis practices. For example, the lack of external support

was cited as a major barrier for the implementation of industrial symbiosis practices. Consequently, policy makers are advised to take steps to support businesses and organizations that seek to establish industrial symbiosis initiatives through, for example, the adoption of financial incentives or the simplification of the administrative processes. Another potential area of improvement is the current policies is the implementation of training programs to facilitate an increase in the workforce's expertise in industrial symbiosis practices, since the lack of specialized personnel has been identified as an important inhibitor.

On the other hand, the existence of political and legal support has been a factor that has facilitated the development of industrial symbiosis initiatives. As a result, policy makers need to take steps to improve their current policies towards this direction. In the same vein, adequate public funding has also contributed to the success of the industrial symbiosis initiatives and should be an area of emphasis for policy makes. Finally, cooperation between businesses and organizations participating in these initiatives represents one of the major enablers, based on the partners' reports. It is thus expected to be highly beneficial if regional authorities could facilitate a collaboration between businesses, research/education institution and potentially public organizations with the aim of promoting the proliferation of industrial symbiosis practices.

Finally, the extension of each symbiotic ecosystem to other territories, partners and collaborations is the key factor to secure the transferability of good symbiotic practices, in order to boost the circularity and sustainability of industrial activities.

4. ANALYSIS ON DATA FROM PARTNERS ON REGIONAL RESPONSES

4.1 General information

For the second survey, each partner was asked to respond to questions concerning the COVID-19 impact on Industrial Symbiosis in their region from the Questionnaire B (see Annex 3), prepared by FUNDECYT. 7 questionnaires were answered overall.

The survey also incorporated elements of a SWOT analysis framework (Strengths, Weaknesses, Opportunities, and Threats); this method aimed to enable policy makers to be realistic about what they could attain and where they should focus to improve their decision making and increase their capacity to deal with future crises.

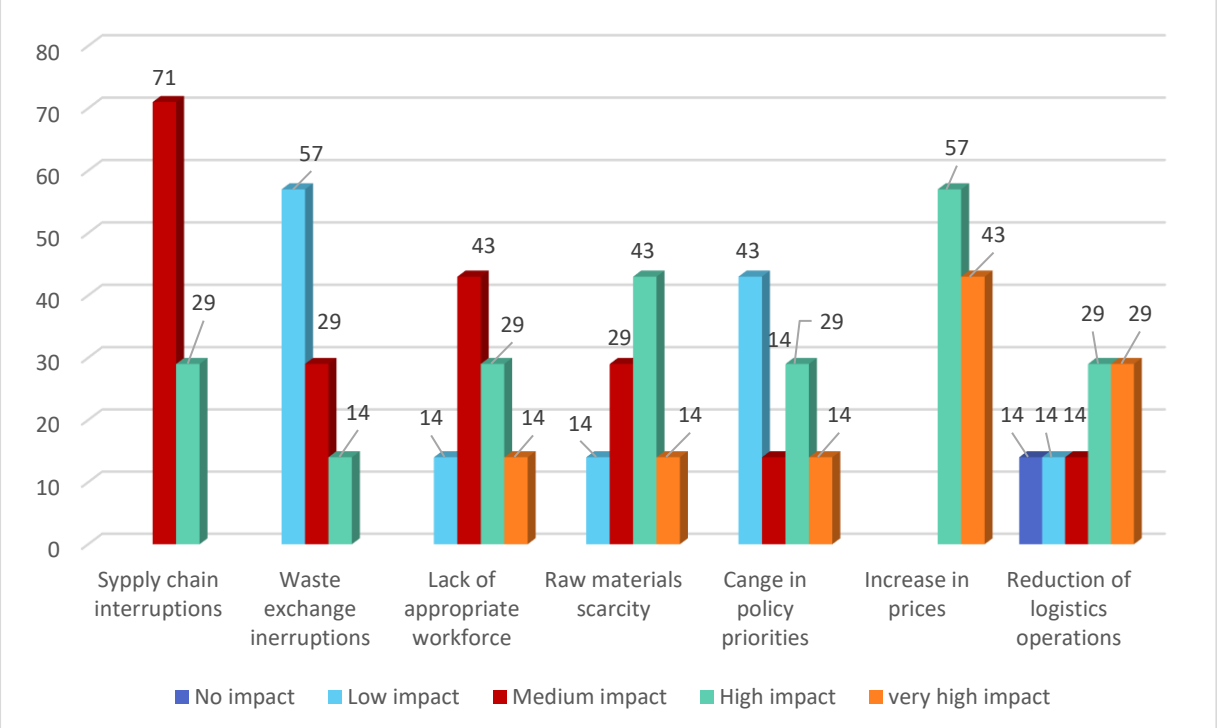
4.2 Analysis

Weaknesses comprise intrinsic characteristics of regional value chains that increase their vulnerability to external events and impair the efforts of regional authorities to support Industrial Symbiosis and circular economy. Partners were asked to shortly describe the weaknesses detected in their regions, elaborating on the extent that IS was impacted by COVID-19. The weaknesses were: a) the pause of investments, b) the workforce disruptions, c) the increased amount of packaging and unsorted waste, d) the delay in circular or IS projects, e) the transportation of materials. The numbers in the figures are calculated in % percentage.

Overall, the sector most affected was tourism.

Threats refer to the challenges identified, therefore the regional disruptions in implementing Industrial Symbiosis / circular waste management approaches.

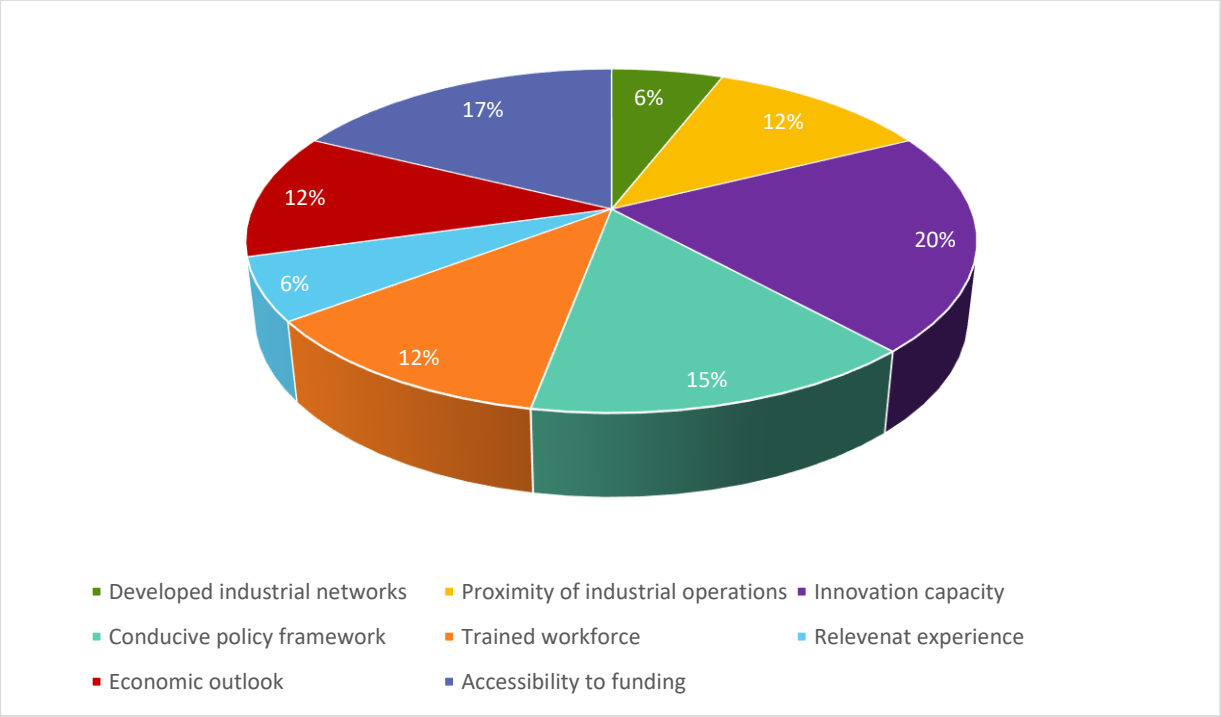
Graph 14 – Barriers identified in regional value chains



From the results, we conclude that the increase in prices of key materials and the raw materials scarcity for the industrial production was highly affected by COVID-19. The pandemic also had a medium impact in the supply chain and a noticeable negative effect in the workforce availability, mostly due to sick leaves and quarantines.

The strengths, i.e. the characteristics of rural SMEs and regional economies that aided regional authorities in supporting the IS and boost regional recovery and resilience in the aftermath of the COVID-19 crisis, are shown in Graph 15.

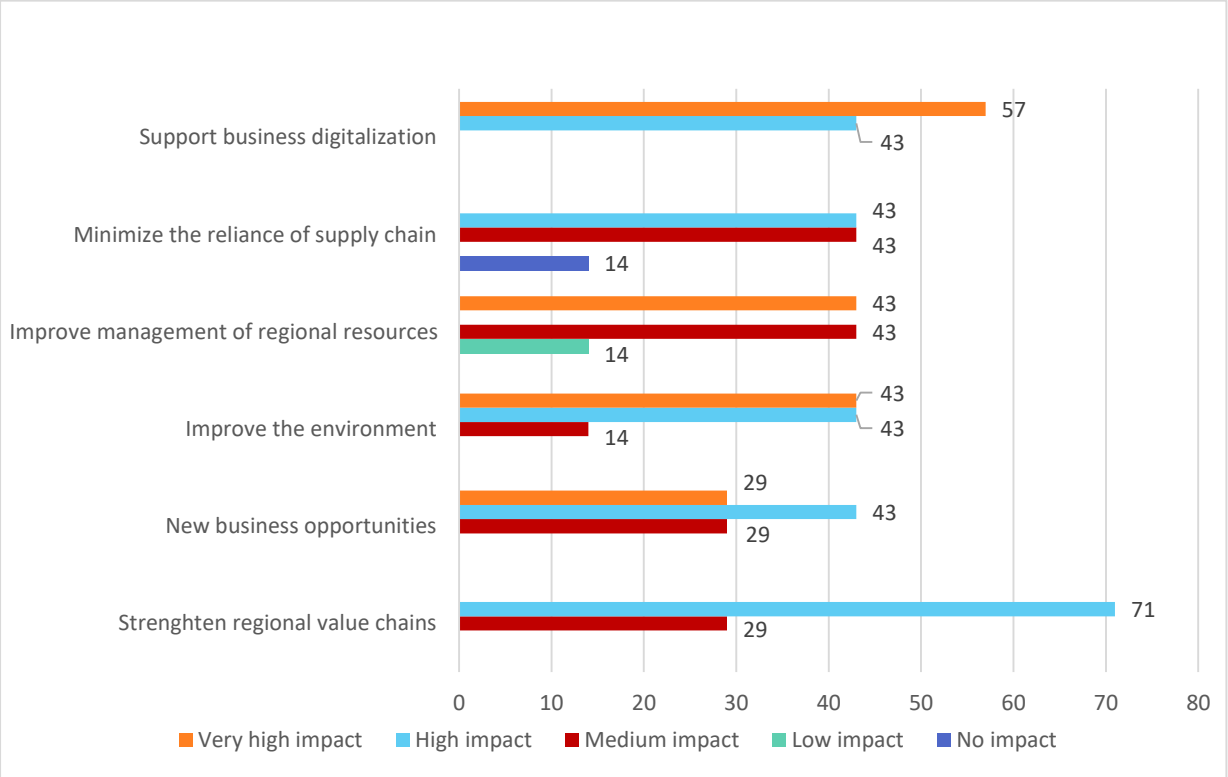
Graph 15 – Strengths detected for regional recovery & resilience



The innovation capacity, the accessibility to new urgent funding through EU urgent support mechanisms, and the conducive policy framework facilitated the fight against the pandemic, by ensuring recovery and resilience paths for regional economies through IS and circular activities (Graph 15).

The category of opportunities is used to identify external factors that would enable SYMBI regional authorities to increase their capacity to deal with COVID-19 as well as future economic crises and, thus, ensure SMEs' viability in such situations. As indicated in Graph 16, strengthening regional value chains and supporting business digitalization have the greatest potential for enhancing regional resilience.

Graph 16 – Enabling factors for resilient regional economy & IS and circular schemes



4.3 Conclusions

The COVID-19 pandemic has created many challenges for businesses (including materials' price inflation and supply chain disruption). At the same time, survey results indicated certain mitigation techniques to facilitate the fight against the COVID-19 economic crisis:

- Ensuring operational security by adapting workflow,
- Finding new markets to mitigate the losses,
- Reducing costs and exploring new resources.

A key finding from this questionnaire is that the impact of the pandemic was not severe on IS plans and activities. On the contrary, the circular and symbiotic initiatives contributed to the regional resilience. Future policy making (and particularly crisis management) could incorporate key aspects of industrial symbiosis practices to confront workforce shortage to increase the overall effectiveness of the applied policies. In addition, the pause of investments, the delay in circular / IS projects, and the disruptions in the transportation of materials were important factors. The waste management circular activities were highly challenged by the increased volume of the waste generated (especially packaging and unsorted waste).

Strengthening the regional value chains to make regional economies more resistant to future crises is the most decisive factor, together with supporting the digital transformation in regional value chains. The recovery and resilience of regional economy and businesses was enhanced by Industrial Symbiosis and circular economy examples, along with the innovation of the related businesses. Policy authorities should therefore encourage such initiatives and contribute to the expansion of regional businesses networks and innovation pathways.

ANNEX 1

Questionnaire A

Questionnaire for identifying symbiotic practices between businesses as a response to the COVID-19 crisis in selected EU countries

Survey objective

This survey is an attempt to document symbiotic practices of circular economy nature, otherwise known as "industrial symbiosis", that were carried out between businesses during and as a response to the pandemic.

In particular, this survey aims to identify cases that two or more businesses collaborated / formed a network to jointly (re)use, recover and/or redirect resources for reuse (e.g., waste, energy, by-products), sharing mutually profitable transactions.

Geographical coverage

The survey is being implemented in the following EU countries: Spain, Poland, Italy, Slovenia, Greece, Hungary, and Finland.

Respondents

This questionnaire is addressed to all SYMBI partners, who are advised to fill it out after having consulted the methodology section on data collection process.

If you would have a question regarding the survey or would like to have access to the final report, please contact the activity leader (i.e., Municipality of Kozani).

Time estimated for completing the questionnaire: 15-20'

A. CONTACT INFORMATION	
A.1 Contact information of the respondent	
Name of respondent:	Click or tap here to enter text.
SYMBI partner:	Click or tap here to enter text.
Contact email:	Click or tap here to enter text.
B. CASE DESCRIPTION	
B.1 Could you please identify the number, names, and economic sector(s) of the businesses / organisations that participate(d) in the symbiotic practice?	
Number of businesses / organisations:	Click here to enter text.
Names of businesses:	Click here to enter text.
Economic sectors involved:	Click here to enter text.
B.2 Could you please identify the type(s) of the participating businesses / organisations? (You can select more than one choice.)	
☐ Large (industrial) enterprises	
☐ Small and medium-sized enterprises	
☐ Eco-industrial parks	
☐ Public authorities	☐ National
	☐ Regional
	☐ Local
☐ NGOs	
☐ Research centres / universities	
☐ Other: Click or tap here to enter text.	
B.3 What is the geographical proximity of the participating businesses / organisations?	

☐ More than one countries involved.

☐ All are located within the same country.

☐ All are located within the same region.

☐ All are located within the same municipality / district.

B.4 What is / are the main type(s) of symbiotic relationship between the participating businesses / organisations?

☐ Exchange of waste
Please, specify: Click or tap here to enter text.

☐ Exchange of energy
Please, specify: Click or tap here to enter text.

☐ Exchange of secondary raw materials
Please, specify: Click or tap here to enter text.

☐ Exchange of other type(s) of by-products
Please, specify: Click or tap here to enter text.

☐ Joint use of services (e.g. transport)
Please specify: Click or tap here to enter text.

☐ Joint use of space
Please specify: Click or tap here to enter text.

☐ Joint use of utility infrastructure
Please specify: Click or tap here to enter text.

☐ Other: Click or tap here to enter text.

B.5 Could you briefly describe the symbiotic relationship between businesses / organisations (i.e., the industrial ecosystem established)? (max. 5 lines)

Click or tap here to enter text.

B.6 Is the symbiotic practice still ongoing?

☐ Yes	☐ No

B.7 If not, how long did it last?

☐ 0-6 months

☐ 7-12 months

☐ 1-2 years

☐ More than 2 years

☐ Other: Click or tap here to enter text.

C. CASE IMPLEMENTATION

C.1 To what extent difficulties were encountered during the implementation of the symbiotic practice?

☐ Major difficulties had been encountered and the symbiotic practice was not fully realised.

☐ Major difficulties had been encountered, which required great effort to be successfully tackled.

☐ Major difficulties had been occasionally encountered, which were threated in time without posing further disturbance.

☐ The symbiotic practice faced minor difficulties and had an overall smooth implementation.

☐ The implementation of the symbiotic practice had no problems or difficulties whatsoever, outperforming implementation expectations.

☐ N / A

C.2 To what extent each of the following challenges has impeded the implementation of the symbiotic practice?
(Please reply on a scale of 1 to 5.)
1 – Not impeded at all
2 – Slightly impeded
3 – Moderately impeded

4 – Greatly impeded
5 – Critically impeded
N/A – Not Applicable / No answer

I.	Lack of personnel					
☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ N / A	
II.	Lack of appropriate training of people involved					
☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ N / A	
III.	Lack of resources					
☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ N / A	
IV.	Lack of communication / cooperation between participating businesses					
☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ N / A	
V.	Lack of appropriate external support (e.g., economic support by public authorities)					
☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ N / A	
VI.	Lack of appropriate technology					
☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ N / A	
VII.	Lack of strategic objectives / planning					
☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ N / A	
VIII.	Other: Click or tap here to enter text.					
☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ N / A	

C.3 Could you please indicate how the implemented symbiotic practice has impacted the business' economic activity?
(Please explain your choice.)

☐ Positive impact Briefly elaborate (1-2 lines): Click or tap here to enter text.	☐ No impact Briefly elaborate (1-2 lines):Click or tap here to enter text.	☐ Negative impact Briefly elaborate (1-2 lines):Click or tap here to enter text.

C.4 Which of the following factors have facilitated the successful implementation of the symbiotic practice?

☐ Geographical proximity of the involved actors
☐ Multiple supply sources which can be easily replaced
☐ Low economic risks
☐ Adequate funding / support from public authorities
☐ Adequate funding / support from private companies (e.g., banks)
☐ Good cooperation among businesses
☐ Previous experience in such synergetic practices
☐ Legal and political support
☐ Other: Click or tap here to enter text.

C.5 What are the most significant features of the industrial eco-system that make it transferable?

☐ Demonstrated benefits outweigh investment costs
☐ Use of standardised technology solutions and processes
☐ Low implementation risks
☐ Small change in daily operations, low risk of organizational resistance
☐ Needs addressed are common among industries, organisations and different regions / countries
☐ Other: Click or tap here to enter text.

C.6 To your knowledge, has / had the symbiotic practice been transferred to different regions and geographical contexts?
(Please explain your choice.)

☐ Yes	☐ No	☐ N / A

If "yes", could you provide further details (e.g., location of synergy): Click or tap here to enter text.

C.7 If another network of businesses wishes to implement this particular symbiotic practice, to what extent there is are adequate resources available? (You can select more than one choice.)

☐ The symbiotic practice has documented in public documents and is easily accessible to the public.
☐ All the required information and data have been documented with descriptive details of the whole implementation process.
☐ There are documented results, which can be consulted by any interested actor.
☐ N / A
C.8 To which of the following business disruptions, caused by the COVID-19 crisis, could the symbiotic practice respond?
☐ Workforce shortage
☐ Disruption in the supply chain
☐ Materials' price inflation
☐ Shortage in raw materials
☐ Disruption in shipping operations
☐ Other: Click or tap here to enter text.
D. FURTHER INFORMATION
D.1 Could you provide any further relevant information or data you consider important (e.g., URL, sources)?
Click or tap here to enter text.

ANNEX 2

Table 2: Evaluation Criteria Breakdown

#	NAME	CRITERIA	POINTS	WF
A. Relevance & Effectiveness				
C.1	Relevance (cumulative sum)	Workforce shortage	1	1
		Disruption in the supply chain	1	
		Materials' price inflation	1	
		Shortage in raw materials	1	
		Disruption in shipping operations.	1	
		Other	1	
C.2	Effectiveness	Major difficulties had been encountered and the symbiotic practice was not fully realised.	1	
		Major difficulties had been encountered, which required great effort to be successfully tackled.	2	
		Major difficulties had been occasionally encountered, which were threated in time without posing further disturbance.	3	
		The symbiotic practice faced minor difficulties and had an overall smooth implementation.	4	
		The implementation of the symbiotic practice had no problems or difficulties whatsoever, outperforming implementation expectations.	5	
B. Implementation				
C.4	Implementation cost	The implementation of the symbiotic practice had a positive impact on the economic activity of the participating business(es).	2	1
		The implementation of the symbiotic practice had no impact on the economic activity of the participating business(es).	1	
		The implementation of the symbiotic practice had a negative impact on the economic activity of the participating business(es).	0	
C.5	Enablers (cumulative sum)	Geographical proximity of the involved actors	1	1
		Multiple supply sources which can be easily replaced	1	
		Low economic risks	1	

		Adequate funding / support from public authorities	1	
		Adequate funding / support from private companies (e.g., banks)	1	
		Good cooperation among businesses	1	
		Previous experience in such synergetic practices	1	
		Legal and political support	1	
		Other	1	
C.3	Barriers **(cumulative sum)**	Lack of personnel	1	-1
		Lack of appropriate training of people involved	1	
		Lack of resources	1	
		Lack of communication / cooperation between participating businesses	1	
		Lack of appropriate external support (e.g., economic support by public authorities)	1	
		Lack of appropriate technology	1	
		Lack of strategic objectives / planning	1	
		Other	1	
C. Transferability				
C.6	Features of transferability **(cumulative sum)**	Demonstrated benefits outweigh investment costs	1	2
		Use of standardised technology solutions and processes	1	
		Low implementation risks	1	
		Small change in daily operations, low risk of organizational resistance	1	
		Needs addressed are common among industries, organisations and different regions / countries	1	
		Other	1	
C.8	Documentation of the implementation process **(cumulative sum)**	The symbiotic practice has documented in public documents and is easily accessible to the public.	1	2
		All the required information and data have been documented with descriptive details of the whole implementation process.	1	
		There are documented results, which can be consulted by any interested actor.	1	
C.7	Transferred to new settings	Yes	1	2
		No	0	
D. Robustness				
B.3	Geographical proximity	More than one countries involved.	1	1
		All are located within the same country.	1	

		All are located within the same region.	2	
		All are located within the same municipality / district.	2	
B.4	Type(s) of symbiotic relationship **(cumulative sum)**	Exchange of waste	1	1
		Exchange of energy	1	
		Exchange of secondary raw materials	1	
		Exchange of other type(s) of by-products	1	
		Joint use of services (e.g., transport)	1	
		Joint use of space	1	
		Joint use of utility infrastructure	1	
		Other	1	

ANNEX 3

Questionnaire B

QUESTIONNAIRE FOR SYMBI ACTIVITY 2 **"Surveying COVID-19 disruptions in industrial production, manufacturing, and waste management in SYMBI regions"**						
Section 1 – State of Play: Description of the current situation (weaknesses)						
Please briefly describe in what way and to what extent the COVID-19 crisis has impacted industrial symbiosis and circular economy in your region. **If applicable, include information regarding the economic sector(s) that were most affected (e.g., business closures and/or layoffs).**						
Section 2 – Threats: Regional disruptions to implementing Industrial Symbiosis / circular waste management approaches						
Q1: Please indicate how much each of the following business disruptions, caused by the COVID-19 crisis, are having an impact on your region's economic sectors and circular economy practices. 1: Negligible / no impact 2: Low impact 3: Medium impact 4: High impact 5: Very high impact N/A: Not applicable / No answer						
Supply chain interruptions: Businesses experienced a breakdown in the manufacturing flow of goods and/or their delivery to customers.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	N/A ☐
Waste exchange interruption: The quality/quantity of industrial waste has decreased, and as a result, businesses could not carry out circular waste management (e.g. lost a source of secondary materials).	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	N/A ☐
Lack of appropriate workforce: COVID-19 restrictions obliged employees to work from home which led to the reduction of the personnel and businesses' overall capacities to carry out on Industrial Symbiosis / circular waste management projects.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	N/A ☐
Raw material scarcity: There is a shortage in several key raw materials, affecting the businesses that were dependent on these materials for their production processes.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	N/A ☐
Change in policy priorities: Due to the COVID-19 crisis, regional authorities focused more on critical sectors (e.g. all available funds were spent in healthcare), de-prioritizing Industrial Symbiosis / circular waste management approaches.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	N/A ☐

Increase in prices of materials: With industries looking to recover from the COVID-19 restrictions and companies trying to stock back up, prices of key materials have significantly increased.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	N/A ☐
Reduction of logistics/shipping operations: Due to COVID-19 restrictions, transportation delays have caused significant disruptions for materials and by-products exchange.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	N/A ☐
Other *(please describe any other COVID-19 disruptions on Industrial Symbiosis / circular waste management processes in your region)*						
1. Click here to enter text.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	N/A ☐
2. Click here to enter text.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	N/A ☐

Section 3 – Strengths: Regional characteristics that could facilitate the deployment of Industrial Symbiosis as a recovery and resilience pathway

Q2: Please indicate which of the following factors that are favourable for deploying Industrial Symbiosis / circular waste management in a post-COVID-19 scenario can be found in your region.

Well-developed industrial networks: The region has already developed the necessary industrial infrastructure to support Circular Economy and Industrial Symbiosis schemes (e.g. eco-industrial parks).	☐
Proximity of industrial operations: Regional businesses are in proximity with each other, which can reduce the shipping operations needed in Industrial Symbiosis and Circular Economy schemes.	☐
Innovation capacity: The region hosts research organizations, universities and/or agencies that perform research in the fields of circular waste management, waste exchange and valorization.	☐
Conducive policy framework: The regional policy framework is conducive to Circular Economy and Industrial Symbiosis schemes or there are relevant policy initiatives underway.	☐
Trained workforce: The region has experienced personnel to develop the technology needed and manage Circular Economy and Industrial Symbiosis schemes.	☐
Relevant experience: Regional businesses have a track record in implementing and/or getting involved in Industrial Symbiosis and/or Circular Economy initiative.	☐
Economic outlook: The region is in a growth trajectory and businesses look for investment opportunities in the fields of Circular Economy and Industrial Symbiosis.	☐
Accessibility to funding: The region has in place funding initiatives that (could) support Circular Economy and Industrial Symbiosis schemes.	☐

Section 4 – Opportunities: Regional recovery and resilience through the deployment of Industrial Symbiosis / circular waste management schemes.

Q3: Please indicate the level of Industrial Symbiosis' / circular waste management's positive impact in addressing regional needs within a recovery and resilience post-COVID-19 policy agenda.

1: Negligible / no impact

2: Low impact

3: Medium impact

4: High impact

5: Very high impact

N/A: Not applicable / No answer

Make regional economies more resistant to future crises, strengthening regional value chains.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	N/A ☐
Create new business opportunities and jobs by facilitating a new economy on waste exchange and valorization.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	N/A ☐
Improve the quality of the environment, reducing CO2 and greenhouse gas (GHG) emissions.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	N/A ☐
Improve the management of regional resources.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	N/A ☐
Decrease the reliance on supply chains beyond your region.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	N/A ☐
Support the digital transformation of businesses.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	N/A ☐

Q5: Based on your answers above, please further elaborate how your region/territory could benefit from industrial symbiosis. Would it be a useful tool for recovery and resilience?