European Commission

Study on the monitoring data on ERDF and Cohesion Fund operations, and on the monitoring systems operated in the 2014-2020 period

Contract N° 2019CE16BAT214 / 2020CE16BAT075

Deliverable 3 and 5:
Report on the methodology to assign typology clusters of operations and beneficiary types and list of clusters

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Table of Contents

List of Figures

List of Tables

List of Boxes

List of Abbreviations

CF	Cohesion Fund
CP(s)	Cooperation Programme(s)
CPR	Common Provisions Regulation
DB	Database
EC	European Commission
EIB	European Investment Bank
EIF	European Investment Fund
EN	English
ERDF	European Regional Development Fund
ESF	European Social Fund
EU	European Union
EUR	Euro (currency)
FoI	Field of Intervention
ICT	Information and Communication Technology
ID	Identification/Identity/Identifier
IP	Investment Priority
MA(s)	Managing Authority(ies)
MS	Member State(s)
N.A.	Not available/Not applicable
NACE	Nomenclature statistique des activités économiques dans la Communauté européenne
NGO	Non-Governmental Organisation
NUTS	Nomenclature des Unités Territoriales Statistiques
OP(s)	Operational Programme(s)
R&D	Research and Development
R&I	Research and Innovation
RTD	Research and Technological Development
RTDI	Research, Technological Development and Innovation
SGC	Societal Grand Challenges
S&T	Science & Technology
SMEs	Small and Medium Enterprises
TC	Territorial Cooperation
TEN-T	Trans-European Transport Network
TEN-E	Trans-European Networks for Energy
TO	Thematic Objective
VAT	Value-Added Tax

FOREWORD

This report (**Deliverable D3 and D5**) presents the strategy and results of clustering operations and beneficiaries into standard typologies. It builds on the data collected, harmonised and included in the Single Database and more specifically on the Database of Operations and the Database of Beneficiaries (Deliverables D1 and D4), as described in Deliverable D2. It also provides an assessment of the categorisation applied by national authorities to operations under the eight category dimensions provided by Annex I of Commission Implementing Regulation (EU) No 215/2014.

The report is organised as follows:

- **Chapter 1** describes the scope and objectives of the clustering exercises for both operations and beneficiaries;

- **Chapter 2** presents the methodology for clustering operations and the resulting typology clusters by Thematic Objective;

- **Chapter 3** presents the approach used for classifying beneficiaries along different dimensions and provides some descriptive statistics;

- **Chapter 4** lists additional potential refinements that could be made to the clustering of operations and beneficiaries.

The report is complemented by an Annex (Annex I) showing for each Thematic Objective the Fields of Interventions (and their combinations) characterising clustered operations and the average share of each Investment Priority and Field of Intervention under each typology cluster.

The report is accompanied by the Database of Operations and Database of Beneficiaries, in .csv format completed with attributes that allow clustering the operations and beneficiaries into typologies (**Deliverable D1 and D4**) as well as by the report describing their structure and content (**Deliverable D2**).

1. Objectives of the clustering

Following regulatory requirements[1], operations are classified according to standard categories in monitoring systems. Among them, the Thematic Objective, Investment Priority (IP), and Field of Intervention (FoI) describe the nature and objective of the operation. While there is a linkage between TOs and IPs (each IP corresponds univocally to one TO), this is not the case for FoIs and TOs. Even though many FoIs are implicitly more relevant for some TOs and IPs than others (e.g., construction of roads or railways is linked to the Thematic Objective 7 related to transport), some FoIs can be relevant for multiple TOs (e.g. R&I processes in SMEs – FoI 064 – is relevant for both strengthening RTDI and SMEs), as shown in Figure 1.

Figure 1:   Grouping of operations according to the Field of Intervention under each Thematic Objective, based on programmes included in the single database of operations
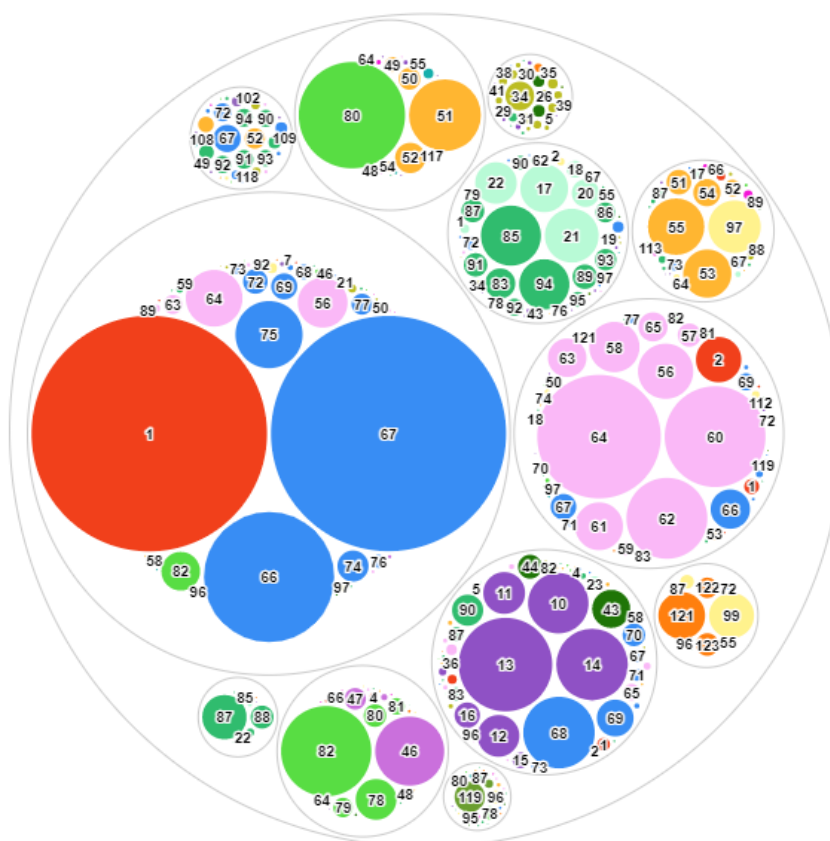
Note: The size of the bubble Represents the number of operations under each FoI. Operations falling under multiple TOs and/or FoIs are counted in all the TOs and/or FoIs they contribute.

Source: Authors

Starting from this multi-dimensional classification, the clustering exercise aimed to classify operations into a manageable number of groups to allow their comparability. In particular, the simplification introduced by the clustering allows having a clearer relation between priorities, actions, indicators and FoIs, streamlining the link from the expenditure

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[1] Categories of interventions listed in Annex I of the Regulation (EU) 215/2014 and Thematic Objectives (TOs) and EU investment priorities (IPs) listed in the Regulation (EU) No 1300/2013 and No 1301/2013

to output indicators until specific strategic objectives. Following the logic adopted in simplifying the programming period 2021-2027[2], **the clustering exercise was based on combining the classification by FoIs and IPs to identify relevant taxonomies under each Thematic Objective**.

It should be noted that the data collection, cleaning, and harmonisation processes implemented by the Core Team showed that the categorisation applied by the national authorities to the operations under the 8 category dimensions provided by Annex I of Commission Implementing Regulation (EU) No 215/2014 presents three main limitations, which should be borne in mind when interpreting the clustering results. In particular:

- **High variability and discretionality in the classification provided by the different Managing Authorities**. Different interpretations of the category dimensions included in the Regulation and different approaches in attributing the standard categories to operations influence the overall comparability of operations based on these categories. The main issue worth mentioning regards the attribution of **unique vs multiple Fields of Intervention (FoIs)**. An issue may arise when classifying complex operations with many components and broad strategic scope, which would suggest involving several codes of Fields of Intervention. Indications by DG REGIO[3] suggest two options in such cases: either adopting a gross approximation using the most prominent part of the operation as the only FoI code or using several codes, allocated based on the pro-rata divisions of expenditures across different Fields of Intervention. While most MAs generally assign a unique FoI, other MAs (in Italy and Hungary, for example) tend to attribute more than one FoIs to the same operation to fully reflect the different components and strategic ambitions without indicating a prevalent one. Others (for example, Poland) distinguish between a predominant field and a list of secondary fields. While the attribution of multiple FoIs in principle adds richness to the information, it also complicates the clustering since it highlights the existence of operations with a hybrid nature that may be classified in different groups. The discretional choice about the strategy to adopt when classifying according to the FoIs may influence the reliability of the categorisation of operations, as similar operations may be classified under different fields depending on the approach adopted by the MA in the attribution of the standard categories. Overall, multiple Fields of Intervention were assigned to 14,609 operations out of 584,828 (i.e., 2.4%), accounting for EUR 31.4 billion (7.9%) of the total eligible expenditure allocated to all selected operations (i.e., EUR 395.3 billion).

- **Errors and inconsistencies in the attribution of EU categories of interventions**. As also shown in Deliverable 2, some errors and inconsistencies were detected during the data cleaning and harmonisation processes by cross-checking information provided for different categories. When possible, such inconsistencies were deleted, but others may not have been detected. In what follows, some illustrative examples of this issue are described.

  - <u>Errors in the attribution of the Form of Finance in Italy and Portugal</u>: In Italy, the body responsible for the management of the central monitoring system confirmed that there might be some errors in the attribution of the Form of Finance, especially in the case of financial instruments. In most cases, they were not classified under the code 03, 04, 05 and 06 as they

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[2] In the current programming period this simplification has been already developed in the new draft Regulations (Regulation (EU) 2021/1058 on the European Regional Development Fund and on the Cohesion Fund).

[3] European Commission (2016). Guidance Note on Nomenclature of Categories of Intervention and the Methodology for Tracking of Climate Change Related Expenditure under Cohesion Policy. EGESIF_15_0019-02 final.

should. Similarly, an analysis of the Portuguese data provided by the central monitoring system revealed no correspondence between the variable Form of Finance and a local taxonomy distinguishing projects from financial instruments.

- o Inconsistencies in the attribution: Some inconsistencies have been identified between hierarchical categories of interventions, i.e., the Thematic Objective and the Investment Priority, and fixed.

- **Missing data on the EU categories of intervention:** In the data collected or provided by the MAs, not all operations are classified according to the EU standard categories of intervention, as this information may be missing in the monitoring system. The information on the Field of Intervention is missing for 16,320 across 55 different programmes, or the EU Investment Priority has not been reported for 47,949 operations across 41 programmes, etc.

Despite these limitations, **categories of interventions represent the most reliable and complete set of information based on which it is possible to classify operations**. Even higher variability characterises other attributes which may be used to describe operations, such as the operation title or description[4]. EU standard categories, instead, provide a harmonised and comparable description of operations. Limitations mentioned above have to be considered an inevitable shortcoming of using these attributes.

For **beneficiaries**, there are no regulatory requirements nor indications guiding Managing Authorities to outline a categorisation, except for the "ownership" dimension for which the computerised storage is laid down by Art. 24 of the Regulation (EU) No 480/2014. Other standard EU categorisations already exist and may be exploited, such as economic activity (i.e. the NACE codes) or the size (for enterprises). However, no legal obligation nor EU standard taxonomy identifies the type of beneficiaries, for example, on the basis of the main type of activity carried out and/or the mission pursued. In this respect, some Managing Authorities store information on the type of beneficiaries receiving EU funds according to a local taxonomy. With the aim to identify the main types of beneficiaries funded in the 2014-2020 programming period by either the ERDF or the CF fund, a harmonised classification of beneficiaries is therefore suggested, building on the available information collected in Deliverable D1 and described in Deliverable D2.

The methodology and approach applied to classify operations and beneficiaries according to harmonised taxonomies are presented in the following Chapters, along with the results of both clustering exercises.

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[4] For instance, in a significant number of cases, the name of the operation and/or its description is simply an acronym, a list of words with no complete meaning, the name of the beneficiary of the operation, or they are even missing.

2. Clustering of operations

2.1 Methodology

The clustering activity was implemented after constructing the Single Database of operations. Therefore, it already considers the cleaning and harmonisations made by the Core Team to the Thematic Objective or the EU Investment Priority that were found to have been inconsistently attributed by Managing Authorities (see Section 3.2.1 of Deliverable 2).

The approach for clustering was carried out in two steps: a first automated clustering using the k-means algorithm to identify the main clusters, then manual verification and re-classification was performed based on an assessment of project description.

Twelve different clustering algorithms have been performed, one per Thematic Objective, using as attributes the EU Investment Priority(ies) and the Field of Intervention(s)[5]. Operations under each TO were clustered according to the share associated with the category within each dimension[6]. For operations with multiple categories under the same dimension, the share corresponds to the related financial pro-rata (see Section 3.2.1 of Deliverable D2). This allows to take into account the relevance of each category within each dimension, e.g., FoI, and so the composition of the project in those cases where more than a FoI/IP was attributed to the operation.[7] Among all clustered operations, 7,265 have multiple FoIs or IPs, while 519,993 have a unique FoI or IP.

Among the possible algorithms, **the preferred one was the k-means method**. This method allows clustering operations with natural similarities in terms of IP and FoI(s) they relate to. Based on the relevance (i.e., average pro-rata shares) of the IP(s) and FOI(s) under each TO, the algorithm aggregates operations by minimising the distance inside the same cluster and maximising the distance among clusters. Under each thematic objective, the optimal number of clusters was identified through the Elbow method. More technical details on how the algorithm works are provided in the Box below.

> **Box 1.The k-means method**
>
> The k-means clustering is a data mining technique that partitions the observations in a number k of clusters by minimising the intra-cluster distance[8]. This clustering algorithm starts with a k-number of centroids (initial values for the centroids are either randomly selected or might be derived from a priori information). Then, each observation is assigned to the closest cluster (i.e., closest centroid). Finally, the centroids are recalculated according to the associated observations. This process is repeated until convergence is achieved. Finally, k-means has a constant weight function, i.e., all observations have equal importance. As with other clustering algorithms, the K-Means has some pros and cons, as shown in the figure below.

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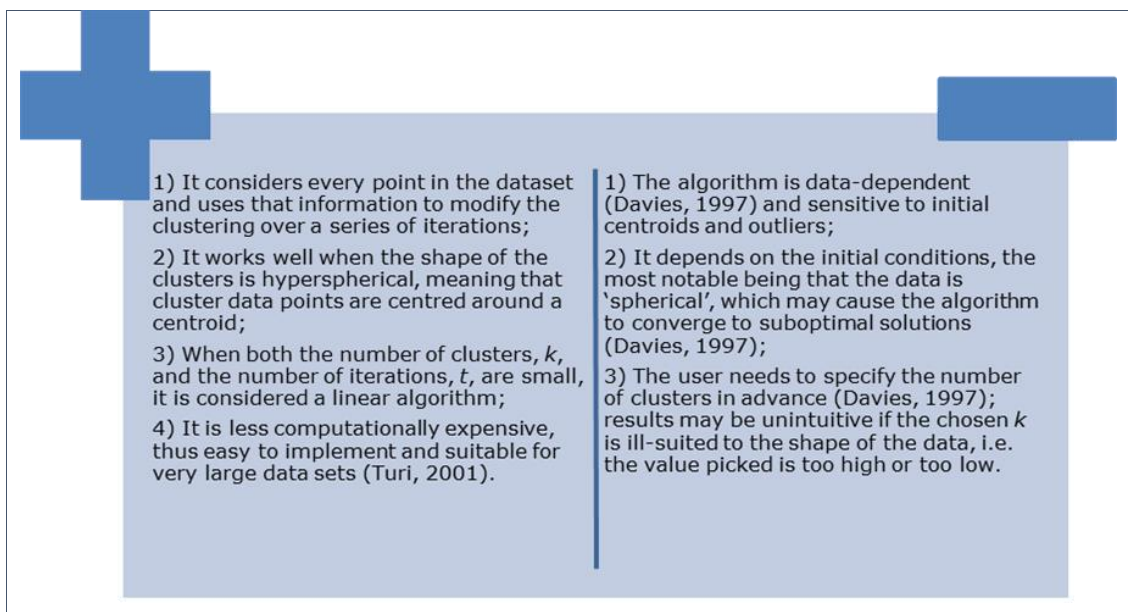
[5] The use of other attributes, such as the economic activity or the beneficiary type, has also been considered. However, they have not been used at this stage, considering that additional operations would have been deleted because of missing data.

[6] Therefore, if an operation was univocally attributed to one IP, e.g., 1a, and one FOI, e.g., 001, the correspondent share is 100% in both cases.

[7] Alternatively, binary variables could have been used instead of pro-rata. This approach would disregard the relevance that a given IP or FoI has for each project and emphasise the fact that a given operation is related to more than a FoI. The Core Team made an attempt to check this approach. The results were not as satisfying as with pro-rata.

[8] Hamerly G. and Elkan C., (2002). "Alternatives to the k-means algorithm that find better clusterings". In: Proceedings of the eleventh international conference on Information and knowledge management—CIKM '02, pp. 600–607.

1) It considers every point in the dataset and uses that information to modify the clustering over a series of iterations;

2) It works well when the shape of the clusters is hyperspherical, meaning that cluster data points are centred around a centroid;

3) When both the number of clusters, k, and the number of iterations, t, are small, it is considered a linear algorithm;

4) It is less computationally expensive, thus easy to implement and suitable for very large data sets (Turi, 2001).

1) The algorithm is data-dependent (Davies, 1997) and sensitive to initial centroids and outliers;

2) It depends on the initial conditions, the most notable being that the data is 'spherical', which may cause the algorithm to converge to suboptimal solutions (Davies, 1997);

3) The user needs to specify the number of clusters in advance (Davies, 1997); results may be unintuitive if the chosen k is ill-suited to the shape of the data, i.e. the value picked is too high or too low.

Source: Authors based on a review of the literature[9]

Operations without financial pro-rata attributions of IP and FoI have been excluded from the clustering[10], which was implemented on a total of 527,258 operations out of 584,828 (90.1%) and representing about 92.4% of the total allocated eligible contribution (EUR 342.7 billion over a total of 370.6 billion)[11]. The distribution of operations across the different TOs is provided in the following Figure.

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[9] Turi R.H., (2001). "Clustering-Based Colour Image Segmentation", PhD Thesis. Monash University, Australia. Davies E., (1997). "Machine Vision: Theory, Algorithms, Practicalities". Academic Press, 2nd Edition.

[10] More specifically, the clustering could not be applied to i) operations with missing data on the TO, IP or FoI and the related pro-rata; ii) operations with multiple TOs; iii) those Portuguese operations for which the Fields of Intervention had been manually attributed by the Core Team (see Part 5 of Section 3.2.1 of Deliverable 2). Moreover, secondary Fields of Interventions, which were available for some Latvian and Polish operations, were not considered.

[11] As shown in Chapter 4, additional operations may be included by filling data gaps in the Investment Priority based on the information available on the Specific Objective and/or measure/action under which the operation is funded.

Figure 2:   Number of operations clustered over the total number of operations by TO[12]
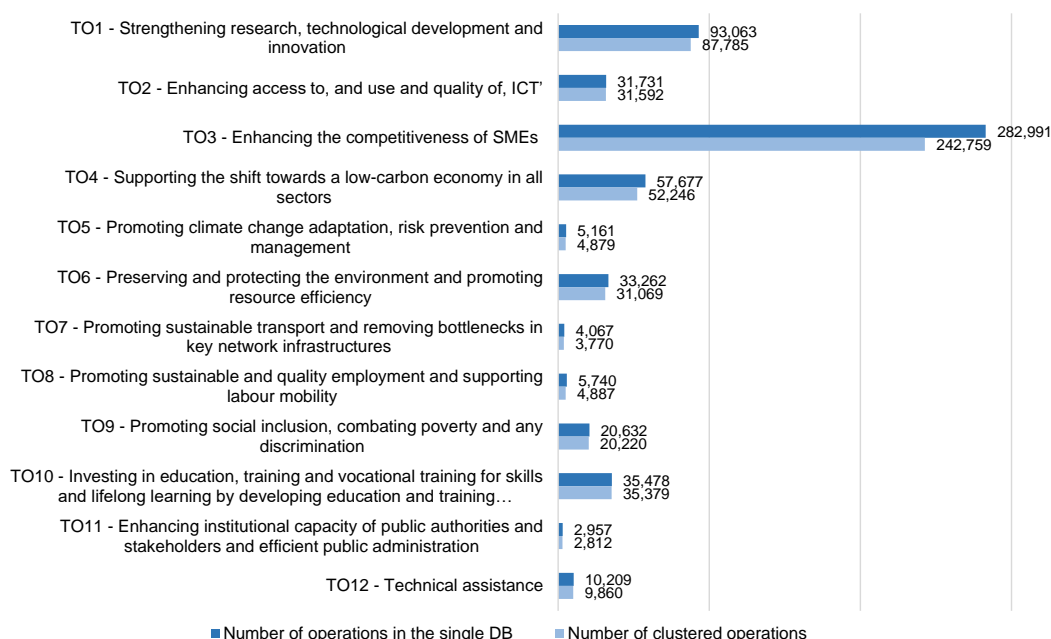
Note: the total number of operations in the single DB does not consider those operations having multiple TOs or having no information on the TO (i.e., 1,860 operations)

Source: Authors

Once the clustering algorithm was performed, for each Thematic Objective, the results of the k-means method were interpreted, validated and revised as follows:

1. **Analysis of the average share of the Investment Priority(ies) and Field(s) of Intervention falling under each typology cluster** identified by the k-means algorithm in order to determine which category or combinations of categories within each dimension characterise each cluster. For instance, under the TO1, one of the six clusters identified by the k-means algorithm included operations that have been classified with the IPs and FoIs shown in the Figure below. The analysis of the average share of these IPs and FOIs highlights that the predominant IP is the 1b and the predominant FoI is 064. Their combination describes the strategic objective and scope of operations belonging to this cluster. Indeed, operations under this cluster aim to promote business investments in R&I, more specifically, R&I processes in SMEs.

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[12] This graph will be updated after re-launching the k-means algorithm on the final version of the Single Database.

Figure 3:   Analysis of the average share of the IPs and FoIs: an example

IP code	IP label	Average share
1b	Promoting business investment in R&I, developing links and synergies between enterprises, research and development centres and the higher education sector, in particular promoting investment in product and service development, technology transfer, social innovation, eco-innovation, public service applications, demand stimulation, networking, clusters and open innovation through smart specialisation, and supporting technological and applied research, pilot lines, early product validation actions, advanced manufacturing capabilities and first production, in particular in key enabling technologies and diffusion of general purpose technologies	100%

FoI code	FoI label	Average share
64	Research and innovation processes in SMEs (including voucher schemes, process, design, service and social innovation)	99.837%
2	Research and innovation processes in large enterprises	0.134%
1	Generic productive investment in small and medium – sized enterprises ('SMEs')	0.006%
82	ICT Services and applications for SMEs (including e-Commerce, e-Business and networked business processes), living labs, web entrepreneurs and ICT start-ups)	0.005%
60	Research and innovation activities in public research centres and centres of competence including networking	0.004%
62	Technology transfer and university-enterprise cooperation primarily benefiting SMEs	0.004%
56	Investment in infrastructure, capacities and equipment in SMEs directly linked to research and innovation activities	0.003%
67	SME business development, support to entrepreneurship and incubation (including support to spin offs and spin outs)	0.003%
81	ICT solutions addressing the healthy active ageing challenge and e-Health services and applications (including e-Care and ambient assisted living)	0.002%
66	Advanced support services for SMEs and groups of SMEs (including management, marketing and design services)	0.001%
69	Support to environmentally-friendly production processes and resource efficiency in SMEs	0.001%

Source: Authors

2. **Analysis of the Field(s) of Intervention co-occurrences within each cluster** to better understand the extent to which the FOIs identified at the previous stage are relevant for the cluster under analysis. As an illustrative example, this type of in-depth analysis, applied to the cluster described in Figure 2, reveals that the FoI 064 is associated with all operations belonging to this cluster and that the remaining FoI identified as marginally relevant are attributed to the operations always in combination with FOI 064, as shown below. This confirms that the FoI 064 is the main field describing the strategic objective of the operations under the cluster.

Figure 4:   Analysis of the FoIs co-occurrences: an example

Combination of FoIs	Number of operations
064	23,681
002|064	122
056|064	4
001|064	3
064|082	3
060|064	2
062|064	2
064|066	1
064|067	1
064|067|082	1
064|069	1
064|081	1
Total	**23,822**

Source: Authors

3. **Attribution of a label to each cluster based on the analysis of the IP(s) and/or FoI(s)** characterising both the cluster under analysis and the other

clusters identified under the same TO. The nature of each cluster is interpreted by looking at the most relevant IPs and FOIs of the cluster under analysis and by looking at the average share compared with the other clusters. For instance, in the example above, the label attributed to the cluster under investigation was inspired by the predominant Field of Intervention label, considering that the IP was also dominant in other clusters. It is 'R&I processes in SMEs'.

4. **Validation of each resulting cluster based on the manual analysis** of operation descriptions and names samples and the related Specific Objective and types of beneficiaries, when relevant. This manual analysis has been performed first by the Core Team and then by the Country Experts. The manual analysis was necessary in particular when clusters were broad and heterogeneous in terms of objectives, in the case of overlapping clusters within TOs or in the case the Core Team has identified operations that seem to be out of the scope of the cluster under which they fall.

5. **Revision of the cluster attribution based on the results of the validation exercise**. This activity consisted of i) splitting of clusters having a broad scope and objective into two more specific clusters to further specify their nature; ii) merging clusters having similar objectives into a unique cluster; iii) moving operations with a specific FoI under another cluster that, based on an analysis of the operation descriptions and names, appears to be more in line with their objective.

2.2 The resulting typologies of operations

The typologies of operations validated and revised following the steps described in the section above are presented for each Thematic Objective. Each section also includes descriptive statistics on the distribution of the total and public eligible expenditure and EU contribution allocated to selected operations by typology cluster.

2.2.1 Typologies of operations under the Thematic Objective 1 'Strengthening research, technological development and innovation'

Thematic Objective 1 funds operations to strengthen research, technological development and innovation. Looking at the Investment Priorities, such operations either enhance research and innovation (R&I) infrastructure and capacities (IP 1a) or promote business investment in R&I (IP 1b).

The clustering activity focused on 87,785 operations out of the total of 93,063 operations falling under TO1 (i.e., 94.3%), covering about 92.3% of the total eligible expenditure allocated to the operations under this TO (whose total allocation in terms of total eligible expenditure is equal to EUR 66.9 billion[13]).

As a result of the implementation of the k-means algorithm and the validation and revision of the clustering results, **a total of six different clusters were identified**, as shown in Figure 5: and summarised in the following table. See Annex I for more details on the average shares of all the IPs and FoIs characterising each cluster.

Table 1 – List of clusters under TO1 and related predominant IPs and FoIs

Typology cluster	Top 1 IP	Top 3 FoIs
Cluster 1 - R&I infrastructure and capacities in research centres	▪ **1a** (100%)	▪ **058** - Research and innovation infrastructure (public): 28.6% ▪ **060** - R+I activities in public research centres: 28% ▪ **064** - R+I processes in SMEs (vouchers, process, design: 26.2% ▪ Other non-predominant FoIs: 17,2%
Cluster 2 - R&I processes in SMEs	▪ **1b** (100%)	▪ **064** - R+I processes in SMEs (vouchers, process, design: 99.8% ▪ Other non-predominant FoIs: 0.2%
Cluster 3 - R&I infrastructure, capacities and equipment in SMEs	▪ **1b** (100%)	▪ **056** - Investment in SMEs directly linked to R+I activities: 93.9% ▪ Other non-predominant FoIs: 6.1%
Cluster 4 - Business investments in R&I	▪ **1b** (100%)	▪ **002** - Research and innovation processes in large enterprises: 21.1% ▪ **061** - R+I activities in private research centres incl. Networks: 19.5% ▪ **066** - Advanced support services for SMEs: 15.7% ▪ Other non-predominant FoIs: 43.7%
Cluster 5 - R&I activities in research centres	▪ **1b** (100%)	▪ **060** - R+I activities in public research centres: 99.8% ▪ Other non-predominant FoIs: 0.2%
Cluster 6 - Technology transfer	▪ **1b** (100%)	▪ **062** - Tech-transfer & university-SME cooperation: 99.9% ▪ Other non-predominant FoIs: 0.1%

Source: Authors

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[13] Please note that the data on the total eligible expenditure is available for 93,020 operations out of 93,063.

Figure 5:   Combinations of IPs and FOIs by cluster under TO1
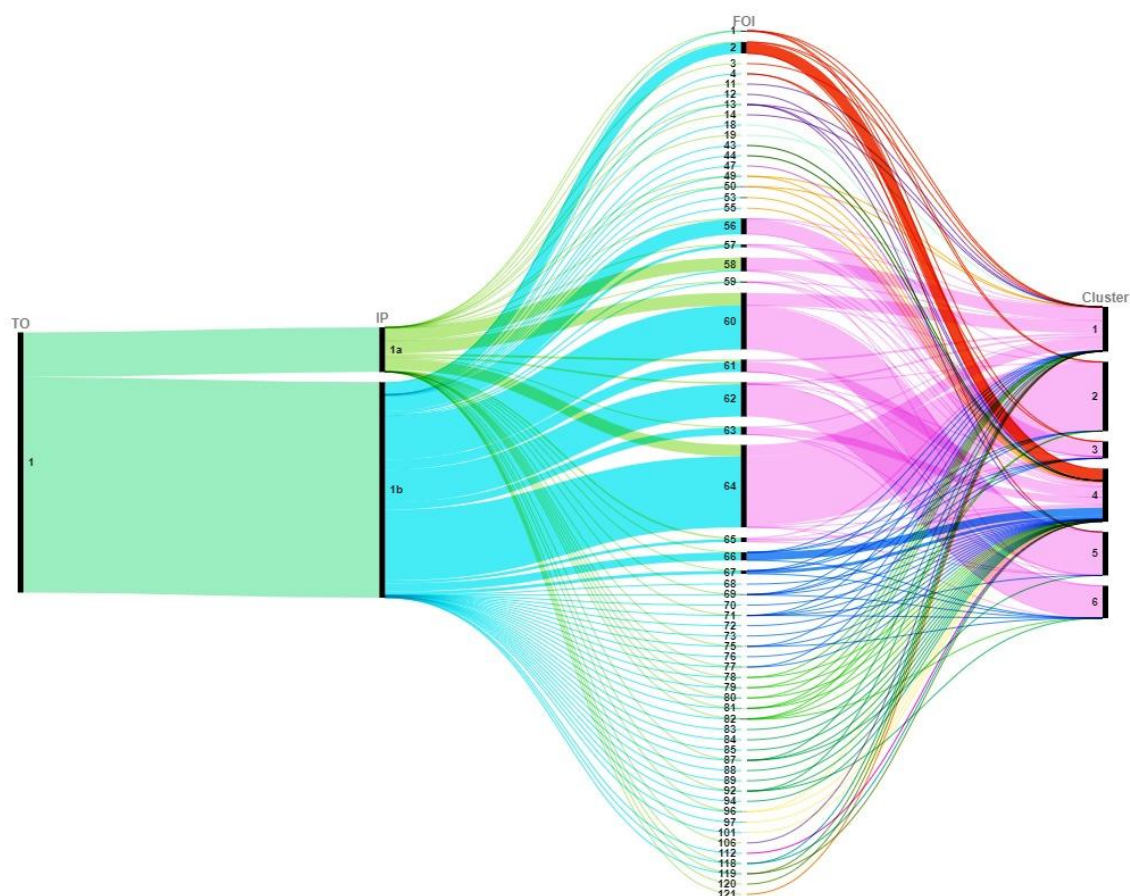
Legend: Cluster 1 - R&I infrastructure and capacities in research centres, Cluster 2 - R&I processes in SMEs, Cluster 3 - R&I infrastructure, capacities and equipment in SMEs, Cluster 4 - Business investments in R&I, Cluster 5 - R&I activities in research centres, Cluster 6 - Technology transfer

Note: the alluvial diagram shows the number of clustered operations under TO1 and their distribution across the different IPs and FoIs Operations with multiple IPs and/or FoIs are counted multiple times.

Source: Authors

In terms of the number of operations, most operations fall under the clusters related to business investments in R&I (those falling under IP 1b), namely Cluster 2, 3, 4. Only 16% of all clustered operations under TO1 are devoted to supporting infrastructures (Cluster 1) and activities in research centres (Cluster 5). 12% of the operations aim to foster technology transfer (Cluster 6) between science and industry actors.

Figure 6:   Number of operations by typology clusters in TO1

Source: Authors

In terms of expenditure, Figure 7: shows that the cluster aimed to promote R&I in businesses (Cluster 4) absorbs the relative highest share of expenditure allocated to TO1. Instead, the smallest percentage is devoted to operations falling under the cluster supporting research and innovation activities to improve networking (Cluster 5).

Figure 7:   Percentage distribution of expenditure by typology clusters of TO1 (in billion EUR)
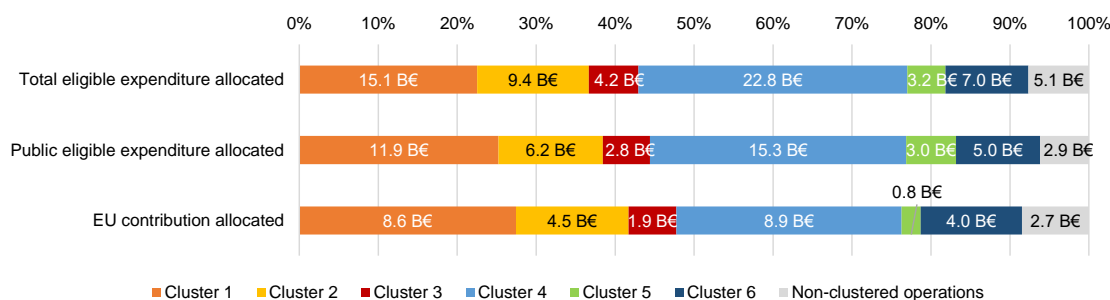
Legend: Cluster 1 - R&I infrastructure and capacities in research centres, Cluster 2 - R&I processes in SMEs, Cluster 3 - R&I infrastructure, capacities and equipment in SMEs, Cluster 4 - Business investments in R&I, Cluster 5 - R&I activities in research centres, Cluster 6 - Technology transfer

Note: the total eligible expenditure allocated to clustered operations under TO1 amounts to EUR 68.9 billion, the eligible public expenditure to EUR 47.01 billion and the total EU allocation to EUR 31.02 billion. It should be noted that not for all operations financial data is available. The total eligible expenditure is available for 93,020 operations out of 93,063; the eligible public expenditure is available for 84,788 operations out of 93,063; the allocated EU contribution is available for 60,007 operations out of 93,063

Source: Authors

Also, when looking at the average expenditure allocated, Cluster 4 funds operations with the highest average expenditure. However, in terms of EU contribution, the cluster enhancing R&I infrastructure and capacities in research centres (Cluster 1) funds operations with a larger average size. This might be explained by the fact that most beneficiaries are public by ownership[14].

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[14] When considering only those beneficiaries having the role of leader, sole beneficiary or final recipients and excluding those beneficiaries which could not be classified using the approach described in Chapter 3.

Figure 8:   Average total eligible, public eligible and EU allocated expenditure by cluster under TO1 (in thousand EUR)
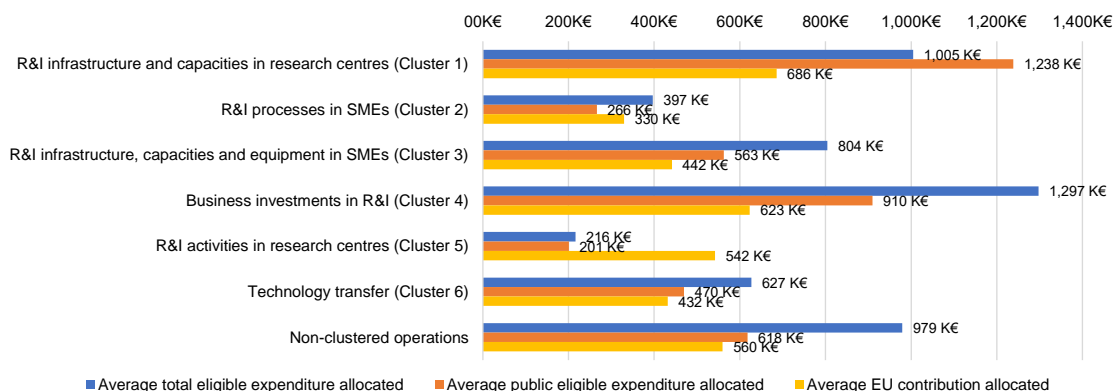
Source: Authors

In what follows, the different typology clusters are further described. It is worth noticing that while most clusters have a specific strategic objective, there is a cluster (cluster 4) that appears to be more heterogeneous, as the list of the predominant FoIs shows.

2.2.1.1   R&I infrastructure and capacities in research centres (Cluster 1)

This is the unique cluster falling under the IP 1a, suggesting that this is the only one including operations aimed at supporting R&I infrastructure and capacities of universities and other research organisations. This interpretation is confirmed because the prevailing Fields of Intervention are 058 and 060, which aim to promote Research and Innovation infrastructures and activities in research centres.

An analysis of the Specific Objective titles also confirmed that these **operations mainly enhance research centres' infrastructural endowment and capacities**, such as universities and other research organisations. The main beneficiaries are higher education institutions and research organisations, representing almost 47% of the total beneficiaries[15], although enterprises also represent a significant share (45%).

2.2.1.2   R&I processes in SMEs (Cluster 2)

This cluster has a clear focus on promoting business R&I. Specifically, it supports research and innovation processes in SMEs (FoI 064), which are the main types of beneficiaries of these operations (98.7% of the total number of enterprises for which a classification on the size was available[16]).

Among the types of operations funded under this cluster, there are, for instance, operations aimed at **improving production methods and processes to favour a technological leap in financed enterprises**.

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[15] This percentage is calculated considering only those beneficiaries having the role of leader, sole beneficiary or final recipients. Partners and other types of beneficiaries have been excluded considering that they were available only for some programmes. Moreover, those beneficiaries which could not be classified using the approach described in Chapter 3 were excluded from the total.

[16] This percentage is calculated considering only those beneficiaries having the role of leader, sole beneficiary or final recipients. Partners and other types of beneficiaries have been excluded considering that they were available only for some programmes. Moreover, those beneficiaries which could not be classified using the approach described in Chapter 3 were excluded from the total.

2.2.1.3 R&I infrastructure, capacities and equipment in SMEs (Cluster 3)

Operations falling under this cluster are also focused on business R&I. However, rather than promoting research and innovation processes, they **support R&I infrastructure, capacities and equipment in SMEs directly involved in research and innovation activities** (FoI 056). Also under this cluster, SMEs represents 95.7% of the total number of enterprises for which a classification on the size was available[17].

These operations are ultimately aimed at supporting the innovative potential of SMEs. They may Include infrastructural investments (including equipment) to enable SMEs to carry out research and innovation activities as well as research and innovation projects, carried out either individually or in collaboration.

2.2.1.4 Business investments in R&I (Cluster 4)

Compared to the previous clusters focused on supporting R&I in businesses, this is a **broad category including a very heterogeneous range of operations supporting activities whose ultimate aim is to promote research and innovation investments in general**, without having a specific focus on research centres or enterprises only. This is shown by the fact that four different FoIs have almost similar average shares, accounting for more than 70% of the average share (i.e., 002. 061, 066 and 063).

Under this category, there are operations aimed at promoting research and innovation processes and infrastructure in large enterprises (FoI 002 and 057) and activities in private research centres (FoI 061). There is also a focus on SMEs and on the need to support them through advanced services (FoI 066) or even cluster organisations (FoI 063) as well as to support entrepreneurship and incubation (FoI 067). **This heterogeneity is also confirmed by the main types of beneficiaries of such operations. The great majority are enterprises**, representing 80% of the total number of beneficiaries[18]. Still, the remaining percentage comprises a wide range of other types of beneficiaries, including higher education institutions, public administrations, research and cluster organisations, chambers of commerce and other businesses associations.

In terms of objectives, some operations aimed at supporting business innovation, others the provision of pro-innovative services to enterprises and others aimed at strengthening the business infrastructure for R&I. There are also operations focusing on the COVID-19 crisis, generally aimed at improving business competitiveness through R&I activities.

However, it is worth noticing that, under this cluster, there are also some operations having Fields of Intervention not directly linked to business support. For instance, there are a total of 249 operations (0.3% of the operations clustered under TO1) related to the FoI of 'Health Infrastructure' (053), whose aim was to provide medical devices and enhance the provision of health services. There are also some operations (a total of 146) whose FoI indicates that they support education infrastructure. From a more in-depth analysis, their ultimate objective is to promote R&I in enterprises by establishing compounds and synergies between companies, R&D facilities, and the university sector.

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[17] This percentage is calculated considering only those beneficiaries having the role of leader, sole beneficiary or final recipients. Partners and other types of beneficiaries have been excluded considering that they were available only for some programmes. Moreover, those beneficiaries which could not be classified using the approach described in Chapter 3 were excluded from the total.

[18] This percentage is calculated considering only those beneficiaries having the role of leader, sole beneficiary or final recipients. Partners and other types of beneficiaries have been excluded considering that they were available only for some programmes. Moreover, those beneficiaries which could not be classified using the approach described in Chapter 3 were excluded from the total.

2.2.1.5   R&I activities in research centres (Cluster 5)

Despite focusing on public research centres, operations falling under this cluster have the ultimate aim of supporting business investments in R&I (IP 1b). This is the main difference between this cluster and Cluster 1. Rather than on infrastructure and capacities, **operations under this cluster have a rationale for promoting research and innovation activities in research centres**. In some cases, these investments were also conceived to pave the way to fruitful relationships between different research and innovation actors, especially between those of the science and business sector (FoI 060).

In terms of beneficiaries, the focus is on Higher Education Institutions and Research organisations (i.e., 79.3% of the beneficiaries[19]). According to an analysis of a sub-sample of Specific Objective titles, most of the operations funded research activities in the field of applied research intending to favour the collaboration between research centres (the main providers of research results) and enterprises (the main user of research results). Overall, the logic is to make the industry sector aware of the value of public research results within the business sphere.

2.2.1.6   Technology transfer (Cluster 6)

In the context of this cluster, **R&I in businesses is promoted by supporting technology transfer processes between different research and innovation actors** (FoI 062). These operations favour collaboration between science and industry actors to support an effective transfer of knowledge between the two.

Beneficiaries of these operations are a mix of science and industry actors, i.e., enterprises, higher education institutions, research organisations, clusters organisations, S&T Parks, other business organisations and public administration authorities. As highlighted by the analysis of some Specific Objective titles, the focus of this cluster is indeed on promoting new products and services and their commercialisation through the transfer of knowledge between science and industry actors.

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[19] This percentage is calculated considering only those beneficiaries having the role of leader, sole beneficiary or final recipients. Partners and other types of beneficiaries have been excluded considering that they were available only for some programmes. Moreover, those beneficiaries which could not be classified using the approach described in Chapter 3 were excluded from the total.

2.2.2 Typologies of operations under the Thematic Objective 2 'Enhancing access to, and use and quality of, ICT'

Thematic Objective 2 funds operations to enhance access to ICT and the use of such technologies and their quality. Specifically, its investment priorities aim at extending the broadband deployment (2a), developing ICT products and services (2b) and strengthening ICT applications and infrastructures (2c).

The clustering activity focused on 31,592 operations out of the total of 31,731 operations falling under TO2 (i.e., 99.5%), covering about 97.4% of the total eligible expenditure allocated to the operations under this TO (whose total allocation in terms of total eligible expenditure is equal to EUR 17.4 billion[20]).

As a result of the implementation of the k-means algorithm and the validation and revision of the clustering results, **a total of three different clusters were identified** based on the combination of IPs and FoIs, as shown in Figure 9: and summarised in the following table. See Annex I for more details on the average shares of all the IPs and FoIs characterising each cluster**Error! Reference source not found.**.

Table 2 –   List of clusters under TO2 and related predominant IPs and FoIs

Typology cluster	Top 1 IP	Top 3 FoIs
Cluster 1 - ICT infrastructures: backbone/backhaul network and broadband	▪ **2a** (100%)	▪ **046** - ICT: High-speed broadband (access/local loop; >/= 30 Mbps): 90.5% ▪ **047** - ICT: V-high-speed broadband (access/local loop; >100 Mbps): 8.7% ▪ Other non-predominant FoIs: 0.8%
Cluster 2 - ICT products and services, especially for enterprises, including e-commerce	▪ **2b** (92%) ▪ Other non-predominant FoIs (8%)	▪ **082** - ICT Services & applications for SMEs: 95.8% ▪ Other non-predominant FoIs: 4.2%
Cluster 3 – **ICT services and infrastructures in the public sector**	▪ **2c** (99.7%) ▪ Other non-predominant FoIs (0.3%)	▪ **078** - e-Government services & applications: 57% ▪ **080** – e-Inclusion, e-Accessibility, e-Learning & e-Education: 15% ▪ **079** - Access to public sector info. (incl. E-tourism, e-culture): 12.3% ▪ Other non-predominant FoIs (4.7%)

Source: Authors

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[20] Please note that the data on the total eligible expenditure is available for 31,729 operations out of 31,731.

Figure 9:   Combinations of IPs and FOIs by TO2 cluster
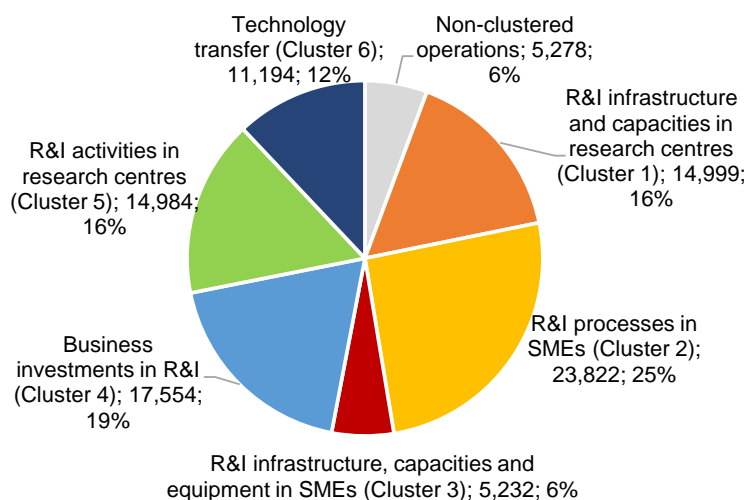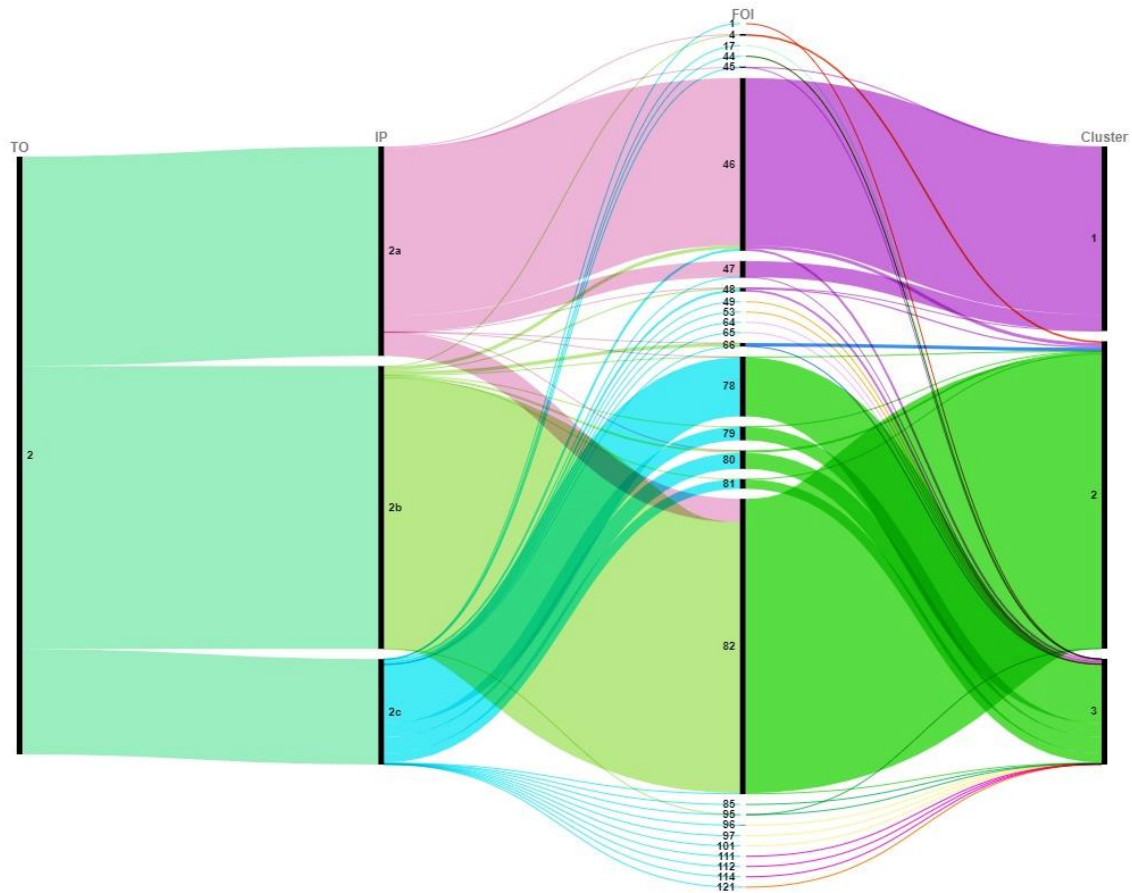

Source: Authors

Note: the alluvial diagram shows the number of clustered operations under TO2 and their distribution across the different IPs and FoIs. Operations with multiple IPs and/or FoIs are counted multiple times.

In terms of the number of operations, most operations fall under the cluster providing ICT products and services, especially to enterprises (Cluster 2). In contrast, ICT investments in the public sector (Cluster 3) account for only 17% of the total number of operations under TO2.

Figure 10:   Number of operations by typology clusters in TO2
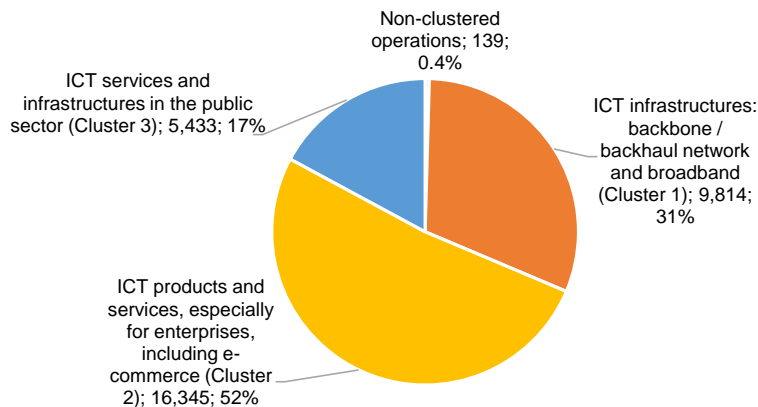
Source: Authors

In terms of expenditure, in contrast, the picture is exactly the opposite. While the cluster promoting ICT in the public sector (Cluster 3) absorbs the relative highest share of expenditure allocated to TO2, the cluster aimed at providing ICT products and services, especially to enterprises, represents the smallest share, i.e., less than 10% of the total eligible expenditure allocated to the operations analysed under TO2.

Figure 11: **Percentage distribution of expenditure by typology clusters of TO2 (in billion EUR)**
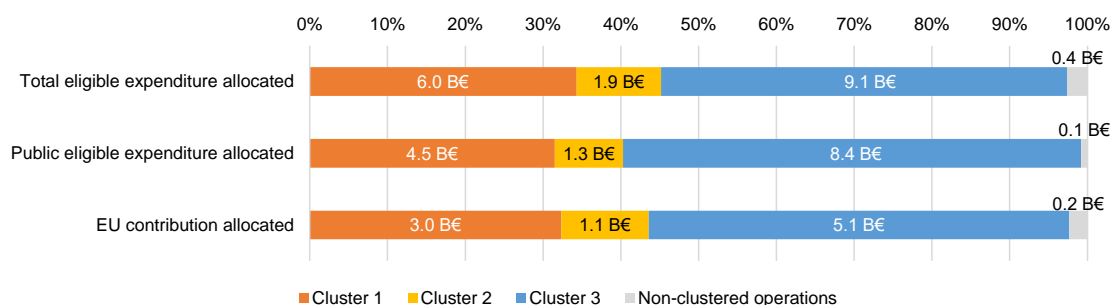
Legend: Cluster 1 - ICT infrastructures: backbone/backhaul network and broadband, Cluster 2 - ICT products and services, especially for enterprises, including e-commerce, Cluster 3 – ICT services and infrastructures in the public sector

Note: the total eligible expenditure allocated to clustered operations under TO2 amounts to EUR 17.4 billion, the eligible public expenditure to EUR 14.3 billion and the total EU allocation to EUR 9.3 billion. It should be noted that not for all operations financial data is available. The total eligible expenditure is available for 31,729 operations out of 31,731; the eligible public expenditure is available for 29,312 operations out of 31,731; the allocated EU contribution is available for 13,958 operations out of 31,731

Source: Authors

Regarding the average total expenditure, it is interesting to note that the operations under the cluster of ICT broadband infrastructures (Cluster 1) have the highest average share of EU contribution, meaning that they have the highest EU co-financing rate.

Figure 12: **Average total eligible, public eligible and EU allocated expenditure by cluster under TO2 (in thousand EUR)**
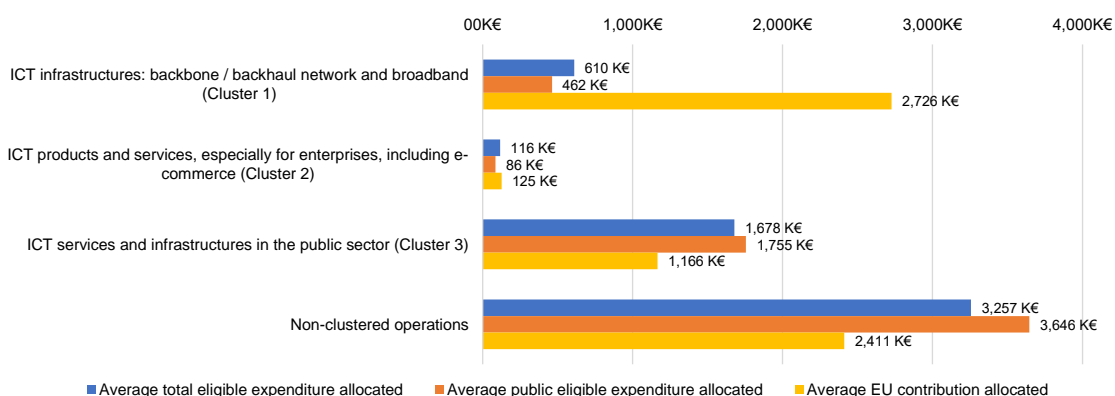
Source: Authors

In what follows, the different typology clusters are further described. It is worth noticing that, compared to the typologies of operations identified under TO1, under this Thematic Objective, the emerging clusters are more homogeneous and reflect the three different investment priorities mentioned above.

2.2.2.1   ICT   infrastructures: backbone/backhaul   network   and broadband (Cluster 1)

Operations falling under this cluster have a very specific focus on extending the high-speed and very high-speed broadband deployment and improving the backbone/backhaul network. **The main objective of such operations is to increase the connection rate of the overall population** in order to reduce digital gaps and improve telecommunication services.

2.2.2.2   ICT   products   and   services,   especially   for   enterprises, including e-commerce (Cluster 2)

With the ultimate aim to enhance the demand for ICT in enterprises, **operations falling under this cluster aimed at developing ICT products and services, especially for commercial purposes**. Indeed, the main types of beneficiaries of such operations are enterprises (more than 83.3%)[21], of which 98% are SMEs (excluding those for which no information on the size was available). In most cases, ICT services (e.g., support to the set-up of webpages or e-commerce platforms) or digital products (e.g., new software, for instance for improving the management system or other business areas, digital security systems, hardware infrastructure for data storage) were provided to companies to enhance their use of digital technologies.

2.2.2.3   ICT services and infrastructure in the public sector (Cluster 3)

Although there is no unique predominant FoI, the typology of operations emerging from this cluster appears to be quite homogeneous in the overall strategic objective. The four FoIs having the highest average shares have the same aim of the Investment Priority associated with this cluster. **They aim to strengthen ICT applications in the public sector, specifically in the government, education, culture, and health sectors**.

The overall ambition of such operations, according to an analysis of the related Specific Objectives, is to improve the quality and, in some specific cases, also the attractiveness (for instance, for cultural sites or education institutions) of government, education, cultural and health services by improving the ICT infrastructure of public institutions and the use of digital services and products. Indeed, more than 96.6% of beneficiaries are public[22].

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[21] This percentage is calculated considering only those beneficiaries having the role of leader, sole beneficiary or final recipients. Partners and other types of beneficiaries have been excluded considering that they were available only for some programmes. Moreover, those beneficiaries which could not be classified using the approach described in Chapter 3 were excluded from the total.

[22] This percentage is calculated considering only those beneficiaries having the role of leader, sole beneficiary or final recipients. Partners and other types of beneficiaries have been excluded considering that they were available only for some programmes. Moreover, those beneficiaries which could not be classified using the approach described in Chapter 3 and for which the information on the ownership is missing were excluded from the total.

2.2.3 Typologies of operations under the Thematic Objective 3 'Enhancing the competitiveness of SMEs'

Thematic Objective 3 funds operations aimed to foster the competitiveness of small-medium sized enterprises. Although operations falling under the TO1 also focus on SMEs in some specific cases, operations under this Thematic Objective, rather than be specifically aimed at improving research and innovation in SMEs, have the ambition to enhance their overall competitiveness. The Investment Priorities suggest the objective to promote entrepreneurship (IP 3a), foster internationalisation (IP 3b), support the creation and extension of advanced capacities for product and service development (IP 3c) and grow in regional, national and international markets (IP 3d).

The clustering activity focused on 242,759 operations out of the total of 282,991 operations falling under TO3 (i.e., 85.7%), but covering about 91.3% of the total eligible expenditure allocated to the operations under this TO (whose total allocation in terms of total eligible expenditure is equal to EUR 71.3 billion[23]).

As a result of the implementation of the k-means algorithm and the validation and revision of the clustering results, **a total of eight different clusters were identified** based on the combination of IPs and FoIs, as shown in Figure 13: and summarised in the following table. See Annex I for more details on the average shares of all the IPs and FoIs characterising each cluster**Error! Reference source not found.**.

Table 3 –   List of clusters under TO3 and related predominant IPs and FoIs

Typology cluster	Top 1 IP	Top 3 FoIs
Cluster 1 - Business creation and consolidation	▪ **3a** (99.9%) ▪ Other non-predominant IPs (0.1%)	▪ **001** - Generic productive investment in SMEs: 99.1% ▪ Other non-predominant FoIs: 0.9%
Cluster 2 - Support to entrepreneurship and incubation	▪ **3a** (100.00%)	▪ **067** - SME business development, entrepreneurship & incubation: 87.9% ▪ **082** - ICT Services & applications for SMEs: 4.2% ▪ **066** - Advanced support services for SMEs: 3.6% ▪ Other non-predominant FoIs: 4.3%
Cluster 3 - Support to internationalisation and visibility	▪ **3b** (100%)	▪ **066** - Advanced support services for SMEs: 60.5% ▪ **001** - Generic productive investment in SMEs: 17.2% ▪ **067** - SME business development, entrepreneurship & incubation: 8.2% ▪ Other non-predominant FoIs: 14.1%
Cluster 4 - Support to productive capacity	▪ **3c** (100%)	▪ **001** - Generic productive investment in SMEs: 99.9% ▪ Other non-predominant FoIs: 0.1%
Cluster 5 - Promoting R&I in enterprises	▪ **3c** (100%)	▪ **075** - Development / promotion of tourism services in/for SMEs: 29.7% ▪ **064** - R+I processes in SMEs (vouchers, process, design: 25.9% ▪ **056** - Investment in SMEs directly linked to R+I activities: 24.1% ▪ Other non-predominant FoIs: 20.3%
Cluster 6 - Productive investment to support SMEs competitiveness	▪ **3d** (100%)	▪ **001** - Generic productive investment in SMEs: 99.6% ▪ Other non-predominant FoIs: 0.4%
Cluster 7 - Business services to support SMEs competitiveness	▪ **3d** (100%)	▪ **067**- SME business development, entrepreneurship & incubation: 42.9% ▪ **066** - Advanced support services for SMEs: 40.7% ▪ **075** - Development / promotion of tourism services in/for SMEs: 3.3% ▪ Other non-predominant FoIs: 13.1%

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[23] Please note that the data on the total eligible expenditure is available for 282,842 operations out of 282,991.

| Cluster 8 - Support to access to finance | ▪ **3c** (100%) | ▪ **067** - SME business development, entrepreneurship & incubation: 100% |

Source: Authors

Figure 13:   Combinations of IPs and FOIs by cluster under TO3
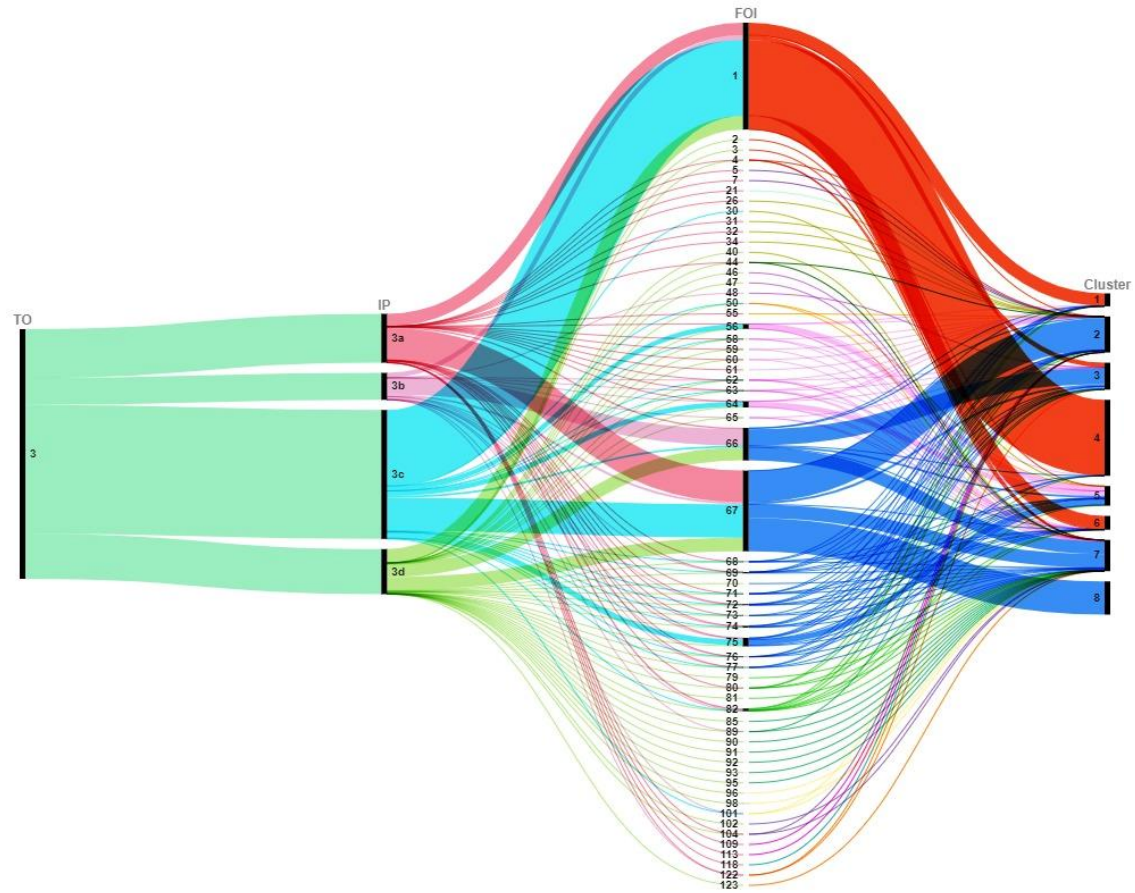
Source: Authors

Note: the alluvial diagram shows the number of clustered operations under TO3 and their distribution across the different IPs and FoIs. Operations with multiple IPs and/or FoIs are counted multiple times.

The cluster providing generic support to productive capacity (Cluster 4) covers most operations. In contrast, the cluster supporting business creation and consolidation (Cluster 1) is less populated in terms of operations.

Figure 14: **Number of operations by typology clusters in TO3**
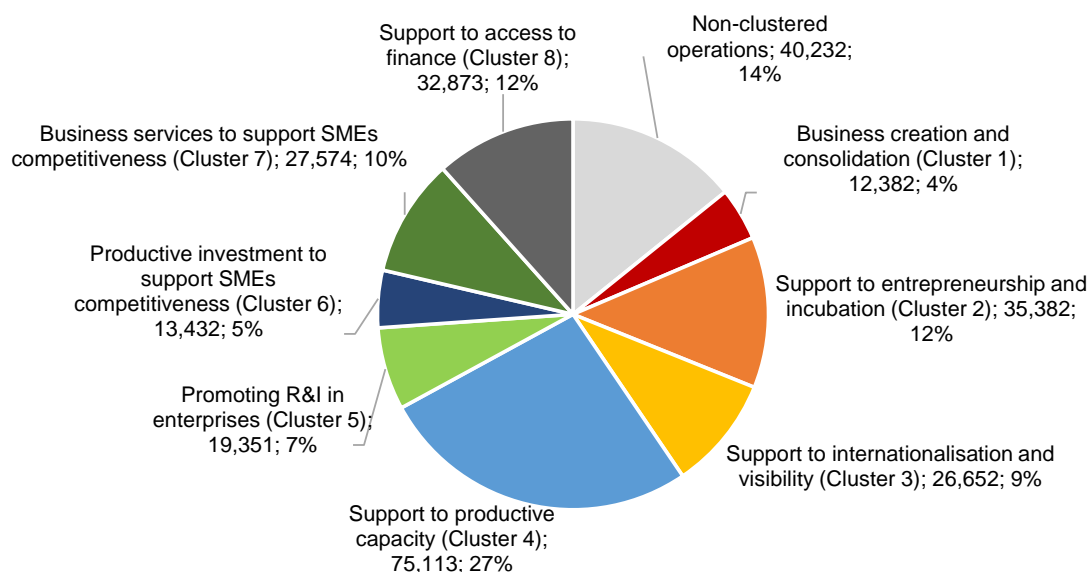
Source: Authors

In terms of expenditure, the cluster providing generic support to productive capacity (Cluster 4) absorbs the highest share of total eligible expenditure allocated, combined with the cluster funding productive investment to support SMEs competitiveness (Cluster 6).

Figure 15: **Percentage distribution of expenditure by typology clusters of TO3 (in billion EUR)**
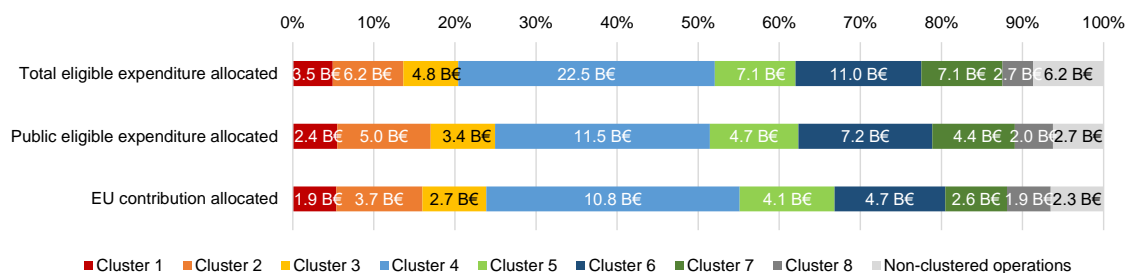
Legend: Cluster 1 - Business creation and consolidation, Cluster 2 - Support to entrepreneurship and incubation, Cluster 3 - Support to internationalisation and visibility, Cluster 4 - Support to productive capacity, Cluster 5 - Promoting R&I in enterprises, Cluster 6 - Productive investment to support SMEs competitiveness, Cluster 7 - Business services to support SMEs competitiveness, Cluster 8 - Support to access to finance

Note: the total eligible expenditure allocated to clustered operations under TO3 amounts to EUR 71.3 billion, the eligible public expenditure to EUR 43.3 billion and the total EU allocation to EUR 34.7 billion. It should be noted that not for all operations financial data is available. The total eligible expenditure is available for 282,842 operations out of 282,991; the eligible public expenditure is available for 270,428 operations out of 282,991; the allocated EU contribution is available for 225,115 operations out of 282,991

Source: Authors

Cluster 6 also funds operations with the average larger size, as shown by the Figure below.

Figure 16: **Average total eligible, public eligible and EU allocated expenditure by cluster under TO3 (in thousand EUR)**
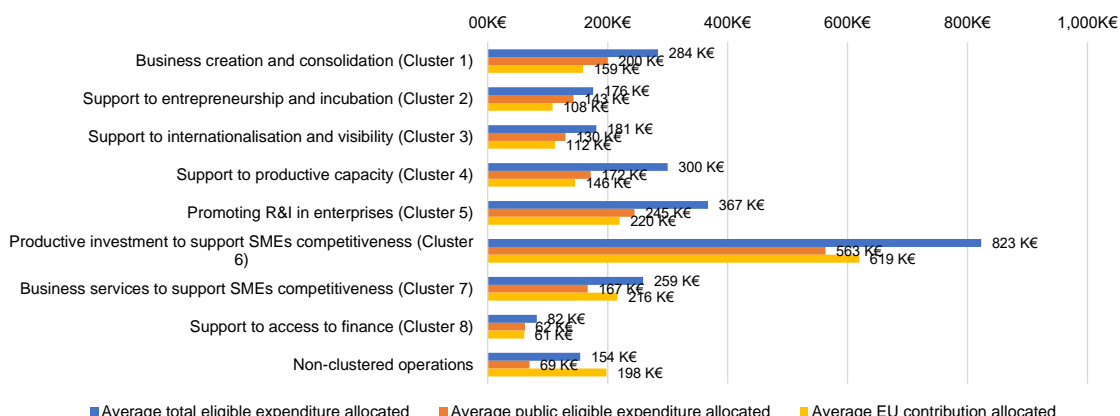
Source: Authors

In what follows, the different typology clusters are further described. It is worth noticing that, similarly to TO1, under this Thematic Objective, the typology clusters are a mix of heterogeneous and homogeneous typology clusters.

2.2.3.1   Business creation and consolidation (Cluster 1)

New or recently established companies need investments for their creation, early development and consolidation, which is exactly what operations under this cluster aim to do. Such investments may relate to creating the business infrastructure and purchasing tangible and intangible assets. However, they may also provide services for developing ICT in the company (e.g., e-commerce, e-business, etc.).

2.2.3.2   Support to entrepreneurship and incubation (Cluster 2)

This is another cluster aimed at favouring the creation of new companies but with a more **specific focus on intangible investments to support entrepreneurship**. Such an objective is pursued mainly by supporting the incubation of new businesses. Operations under this cluster may fund services for new start-up companies and individual entrepreneurs to develop their ideas into business concepts.

2.2.3.3   Support to internationalisation and visibility (Cluster 3)

This is the unique cluster with the specific objective of **supporting SMEs (or all enterprises) in going international**. This is done mainly through support for participation in fairs, partner search, incoming missions, and promotional and visibility actions.

2.2.3.4   Support to productive capacity (Cluster 4)

This cluster aims to promote the development of the productive capacity of SMEs or enterprises in general. This is done by favouring their upgrade through generic productive investments, such as expanding or modernising their infrastructure and equipment.

2.2.3.5   Promoting R&I in enterprises (Cluster 5)

The main strategic objective of the cluster is to promote R&I in enterprises. More than 50% of operations focus on promoting R&I in SMEs (FoI 064 and 056) and aim at developing research and innovation processes in SMEs or fund investments in infrastructure, capacities and equipment in SMEs directly linked to research and innovation activities. Their ultimate aim is to support a technology upgrade in already existing enterprises to increase innovation, managerial and organisational innovation, and the commercialisation of innovative products. There is, however, a less significant share of operations aimed at developing commercial tourism services in SMEs (FoI 075), concentrated in some OPs in Greece, Italy, and Portugal.

2.2.3.6   Productive investments to support SMEs competitiveness (Cluster 6)

Operations under this cluster may differ among them and generally consist of generic productive investments in SMEs. Their ultimate objective is to **support the capacity of SMEs to grow in regional, national and international markets and, therefore, to become more competitive at different levels**.

2.2.3.7   Business services to support SMEs competitiveness (Cluster 7)

Similar to the previous cluster, operations falling under this typology have the ultimate aim of **supporting the capacity of SMEs to grow in regional, national and international markets**. However, they pursue this objective by funding other types of projects as compared to the previous cluster. Rather than funding productive tangible investments, they are more focused on **supporting entrepreneurship and SME business development** and they provide generic support services to SMEs.

2.2.3.8   Support to access to finance (Cluster 8)

The combination of the predominant IP (3c) and FoI (067) of this cluster may suggest that its main goal is to support the development of enterprises by improving their skills and capacities. However, from a more in-depth analysis of the operation descriptions, it emerged that more than half of the **operations under this cluster provided liquidity** to:

● Help different types of enterprises cope with the negative consequences of the COVID-19 crisis pandemic;

● Create new commercial businesses, such as bars, small shops or restaurants.

2.2.4 Typologies of operations under the Thematic Objective 4 'Supporting the shift towards a low-carbon economy in all sectors'

Thematic Objective 4 funds operations aimed to support the shift towards a low-carbon economy, irrespective of the target sector. This is done by promoting the production and distribution of energy derived from renewable sources (IP 4a) and their use in enterprises (IP 4b) as well as in public buildings and the housing sector (IP 4c). Operations under this thematic objective may also develop and implement smart distribution systems that operate at low and medium voltage levels (IP 4d) or promote:

● Low-carbon strategies for all types of territories, in particular for urban areas (IP 4e);

● Research and innovation in, and adoption of, low-carbon technologies (IP 4f);

● The use of high-efficiency co-generation of heat and power based on useful heat demand (IP 4g)

The clustering activity focused on 52,246 operations out of the total of 57,677 operations falling under TO4 (i.e., 90.6%), but covering 90% of the total eligible expenditure allocated to the operations under this TO (whose total allocation in terms of total eligible expenditure is equal to EUR 55.8 billion[24]).

As a result of the implementation of the k-means algorithm and the validation and revision of the clustering results, **a total of seven different clusters were identified** based on the combination of IPs and FoIs, as shown in Figure 17: and summarised in the following table. See Annex I for more details on the average shares of all the IPs and FoIs characterising each cluster**Error! Reference source not found.Error! Reference source not found.**.

Table 4 –   List of clusters under TO4 and related predominant IPs and FoIs

Typology cluster	Top 1 IP	Top 3 FoIs
Cluster 1 - R&I for the development and use of low-carbon solutions	▪ **4f** (74.4%) ▪ Other non-predominant FoIs (25.6%)	▪ **069** - Support to enviro-friendly production processes in SMEs: 31% ▪ **016** - High efficiency co-generation and district heating: 15.7% ▪ **015** - Intelligent Energy Distrib. Systems (incl. smart grids): 10.1% ▪ Other non-predominant FoIs: 43.2%
Cluster 2 - Energy efficiency and use of renewable energy in business production processes	▪ **4b** (96.2%) ▪ Other non-predominant FoIs (3.8%)	▪ **069** - Support to enviro-friendly production processes in SMEs: 32.4% ▪ **010** - Renewable energy: solar: 23.1% ▪ **070** - Promotion of energy efficiency in large enterprises: 22.3% ▪ Other non-predominant FoIs: 22.2%
Cluster 3 - Energy efficiency renovation in enterprise buildings	▪ **4b** (99.8%) ▪ Other non-predominant IPs (0.02%)	▪ **068** - Energy efficiency & demo. projects in SMEs100%
Cluster 4 - Energy efficiency renovation in the housing sector	▪ **4c** (99.99%) ▪ Other non-predominant IPs (0.01%)	▪ **014** - Energy efficiency renovation of housing stock & demo: 80.5% ▪ **010** – Renewable energy: solar: 7.7% ▪ **016** – High efficiency co-generation and district heating: 3.5% ▪ Other non-predominant FoIs: 8.3%
Cluster 5 - Energy efficiency, smart energy management	▪ **4c** (99.9%),	▪ **013** - Energy efficiency renovation of public infra. & demo: 99.9%

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[24] Please note that the data on the total eligible expenditure is available for 57,651 operations out of 57,677.

and renewable energy use in public buildings	▪ Other non-predominant IPs (0.1%)	▪ Other non-predominant FoIs: 0.01%
Cluster 6 - Production and distribution of energy derived from renewable sources	▪ **4a** (99.98%) ▪ Other non-predominant IPs (0.02%)	▪ **010** – Renewable energy: solar: 52.2% ▪ **011** - Renewable energy: biomass: 17.9% ▪ **012** - Other renewable energy (hydro, geo, etc) & RE integration: 14.8% ▪ Other non-predominant FoIs: 15.1%
Cluster 7 - Adoption of low-carbon solutions, especially in the transport and mobility sector	▪ **4e** (100.00%)	▪ **043** - Clean urban transport infrastructure & promotion : 35.9% ▪ **090** - Cycle tracks and footpaths 22.6% ▪ **044** - Intelligent transport systems 9.9 % ▪ Other non-predominant FoIs (21.9%

Source: Authors

Figure 17:   Combinations of IPs and FOIs by cluster of the TO4
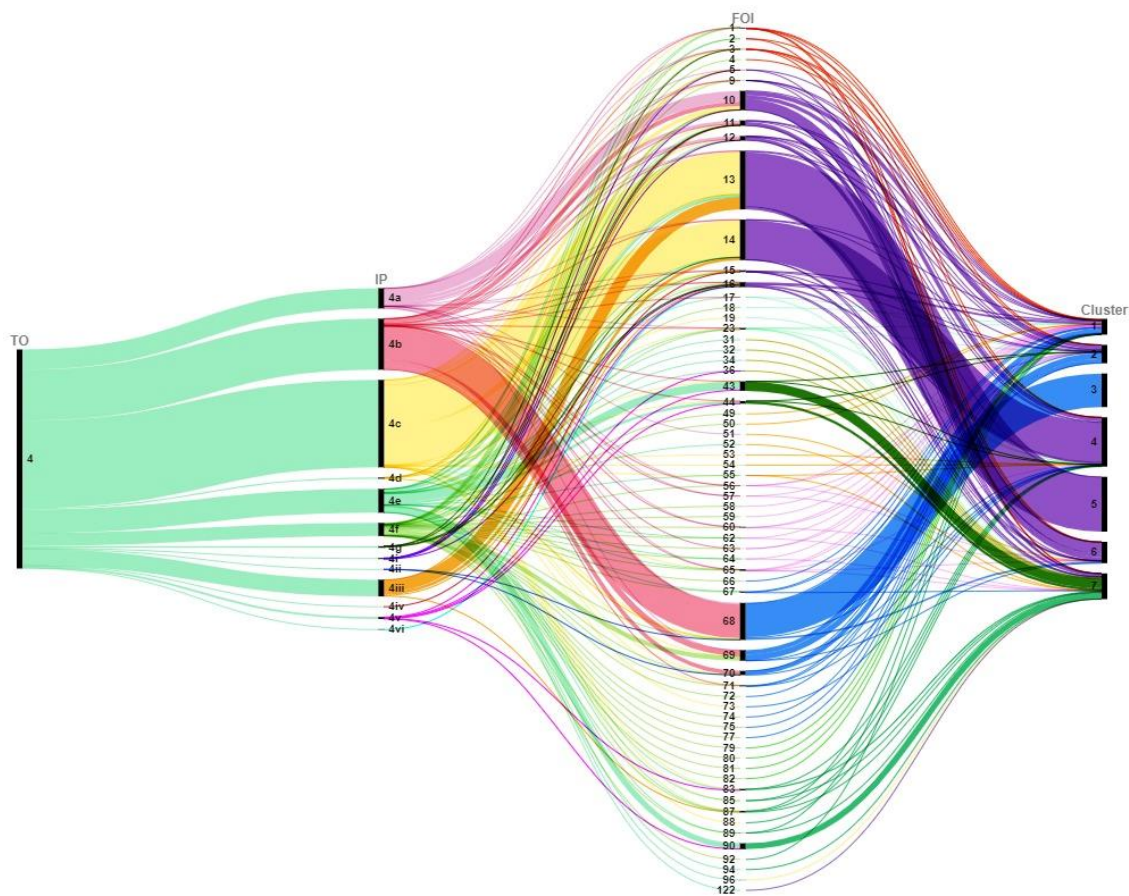
Source: Authors

Note: the alluvial diagram shows the number of clustered operations under TO4 and their distribution across the different IPs and FoIs. Operations with multiple IPs and/or FoIs are counted multiple times.

Operations devoted to promoting energy efficiency, smart energy management and renewable energy use in public buildings (Cluster 5) are the most significant in terms of the number of operations covered. In contrast, those providing generic support to R&I for and use of low-carbon solutions (Cluster 1) are only a residual percentage of the total (5.6%).

Figure 18:   Number of operations by typology clusters in TO4
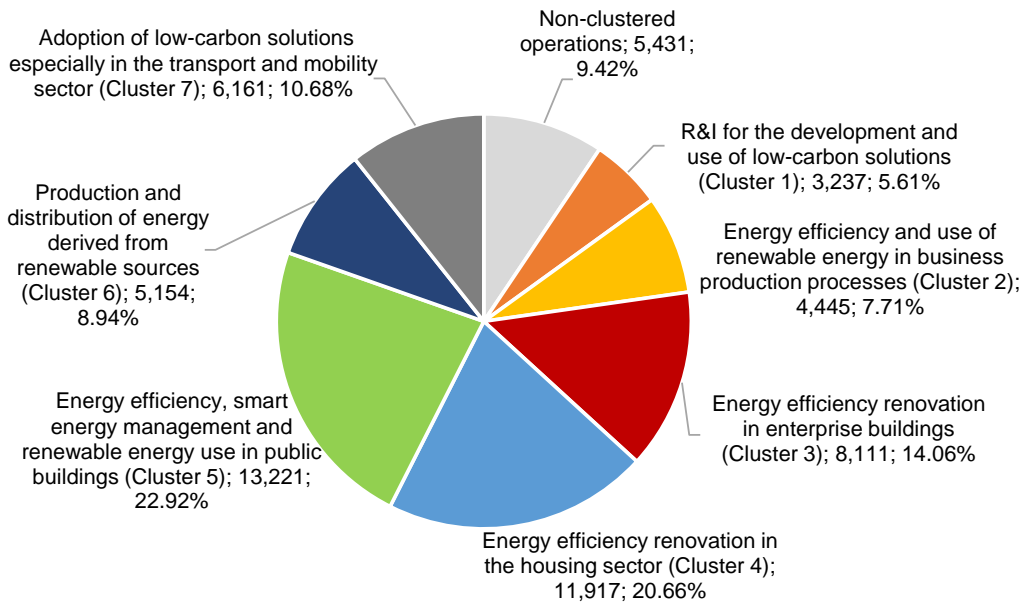
Source: Authors

However, in terms of expenditure, the cluster supports the adoption of low-carbon solutions, especially in the transport and mobility sector (Cluster 7), which absorbs the highest amount of total eligible expenditure allocated. Operations supporting energy efficiency renovation in enterprises (Cluster 3) are less relevant than the others in financial terms.

Figure 19:   Percentage distribution of expenditure by typology clusters of TO4 (in billion EUR)
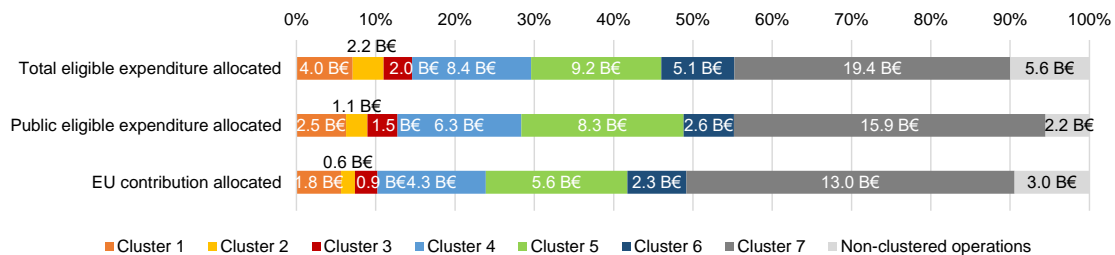
Legend: Cluster 1 - R&I for the development and use of low-carbon solutions, Cluster 2 - Energy efficiency and use of renewable energy in business production processes, Cluster 3 - Energy efficiency renovation in enterprise buildings, Cluster 4 - Energy efficiency renovation in the housing sector, Cluster 5 - Energy efficiency, smart energy management and renewable energy use in public buildings, Cluster 6 - Production and distribution of energy derived from renewable sources, Cluster 7 - Adoption of low-carbon solutions, especially in the transport and mobility sector

Note: the total eligible expenditure allocated to clustered operations under TO4 amounts to EUR 55.8 billion, the eligible public expenditure to EUR 40.5 billion and the total EU allocation to EUR 31.4 billion. It should be noted that not for all operations financial data is available. The total eligible expenditure is available for 651 operations out of 57,677; the eligible public expenditure is available for 52,533 operations out of 57,677; the allocated EU contribution is available for 41,948 operations out of 57,677

Source: Authors

Operations under Cluster 7 are also the ones having the largest average size. Those supporting energy efficiency renovation in enterprises (Cluster 3) are instead those with the smallest size.

Figure 20: Average total eligible, public eligible and EU allocated expenditure by cluster under TO4 (in thousand EUR)
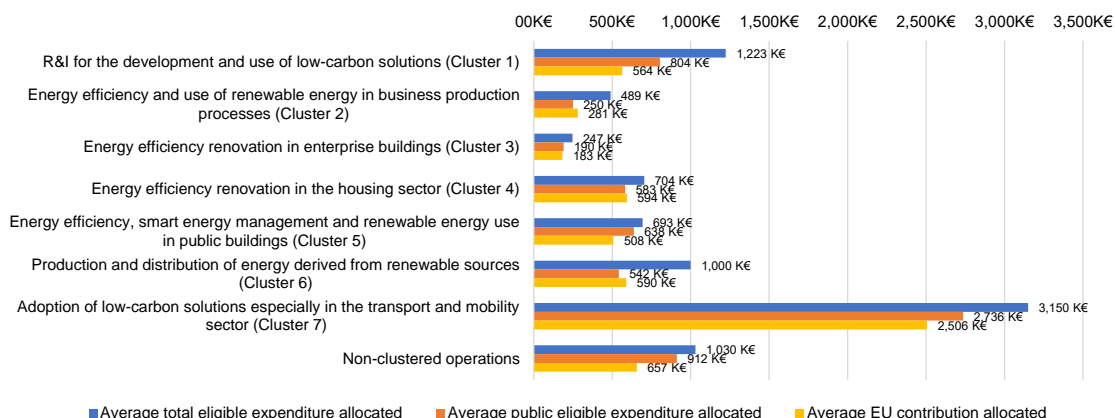
Source: Authors

In what follows, the different typology clusters are further described. Similarly to the previous Thematic Objectives, also, in this case, the k-means method identified some clusters with very specific strategic objectives and a cluster being more heterogeneous.

2.2.4.1   R&I for the development and use of low-carbon solutions (Cluster 1)

Under this cluster, there is a mix of operations either consisting of **R&I activities aimed at adopting low-carbon technologies or supporting high-efficiency co-generation of heat and power-based**. There is also a residual portion of operations aimed to develop and implement smart distribution systems that operate at low and medium voltage levels.

2.2.4.2   Energy efficiency and use of renewable energy in business production processes (Cluster 2)

With a strong focus on enterprises (i.e., 93% of beneficiaries[25]), this cluster funds operations whose aim is to **promote energy efficiency and renewable energy use in all types of enterprises, specifically in their production processes**. The idea is to make industrial production processes more sustainable and reduce their carbon footprint, for instance by purchasing advanced equipment or machines used in the industrial process.

2.2.4.3   Energy efficiency renovation in enterprise buildings (Cluster 3)

This cluster is also focused on enterprises (i.e., 88% of beneficiaries[26]), but its strategic objective is not to promote sustainable production processes but rather to **renovate and thus improve the energy efficiency of the buildings in which enterprises operate**.

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[25] This percentage is calculated considering only those beneficiaries having the role of leader, sole beneficiary or final recipients. Partners and other types of beneficiaries have been excluded considering that they were available only for some programmes. Moreover, those beneficiaries which could not be classified using the approach described in Chapter 3 were excluded from the total.

[26] This percentage is calculated considering only those beneficiaries having the role of leader, sole beneficiary or final recipients. Partners and other types of beneficiaries have been excluded considering that they were available only for some programmes. Moreover, those beneficiaries which could not be classified using the approach described in Chapter 3 were excluded from the total.

Examples of projects are the acquisition of new technologies to reduce current energy consumption, renovating buildings to improve the energy performance class, converting the lighting system to LED technology, etc.

2.2.4.4 Energy efficiency renovation in the housing sector (Cluster 4)

Operations under this cluster have the clear **strategic objective of promoting energy efficiency renovation of existing housing buildings**. Operations generally consist of reconstructing existing apartment buildings by renovating their façades or the lighting system, installing solar panels, etc.

2.2.4.5 Energy efficiency, smart energy management and renewable energy use in public buildings (Cluster 5)

Operations under this cluster pursue the same strategic objective as Cluster 3 and 4, but rather than in enterprises or apartment buildings, **it focuses on public buildings**[27].

2.2.4.6 Production and distribution of energy derived from renewable sources (Cluster 6)

The focus of operations under this cluster is to **support and promote the production and distribution of energy derived from renewable sources**, such as solar energy, biomass energy, geothermal energy, etc. Generally, those operations invested in acquiring renewable energy installations to increase their overall use.

2.2.4.7 Adoption of low-carbon solutions, especially in the transport and mobility sector (Cluster 7)

The focus of this cluster is specifically on the transport and mobility sector. The idea of operations falling under this cluster is to **support the adoption of low-carbon solutions** to enhance the clean urban transport infrastructure, increase the availability of cycle tracks and footpaths, and adopt intelligent transport systems.

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[27] 98% of the total number of beneficiaries (leader, sole beneficiary or financial recipient) for which the information on the ownership was available are indeed public.

2.2.5 Typologies of operations under the Thematic Objective 5 'Promoting climate change adaptation, risk prevention and management'

Thematic Objective 5 funds operations aimed at promoting climate change adaptation (IP 5a) and investments to address specific risks related to the occurrence of natural or human disasters, also not specifically linked to climate change (IP 5b).

The clustering activity focused on 4,879 operations out of the total of 5,161 operations falling under TO5 (i.e., 94.5%), thus covering 90.8% of the total eligible expenditure allocated to the operations under this TO (whose total allocation in terms of total eligible expenditure is equal to EUR 10.5 billion[28]).

As a result of the implementation of the k-means algorithm and the validation and revision of the clustering results, **a total of four different clusters were identified** based on the combination of IPs and FoIs, as shown in Figure 21: and summarised in the following table. See Annex I for more details on the average shares of all the IPs and FoIs characterising each cluster**Error! Reference source not found.Error! Reference source not found.**.

Table 5 –   List of clusters under TO5 and related predominant IPs and FoIs

Typology cluster	Top 1 IP	Top 3 FoIs
Cluster 1 - Environmental risk prevention	▪ **5b** (100.00%)	▪ **089** - Rehabilitation of industrial sites and contaminated land: 61.3% ▪ **021** - Water management & drinking water conservation: 20.4% **085** - Biodiversity, nature protection & green infrastructure: 15.5% ▪ Other non-predominant FoIs: 2.8%
Cluster 2 - Climate-related risks prevention	▪ **5b** (100.00%)	▪ **087** - Adapt to climate change & prevent & manage climate risks: 99.9% ▪ Other non-predominant FoIs: 0.1%
Cluster 3 - Management and mitigation of climate change consequences	▪ **5a** (100.00%)	▪ **087** - Adapt to climate change & prevent & manage climate risks: 98.5% ▪ Other non-predominant FoIs: 1.5%
Cluster 4 - Investments to manage consequences and prevent non-climate related risk	▪ **5b** (100.00%)	▪ **088** - Rehabilitation of industrial sites and contaminated land: 99.9% ▪ Other non-predominant FoIs: 0.1%

Source: Authors

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[28] Please note that the data on the total eligible expenditure is available for 5,148 operations out of 5,161.

Figure 21:   Combinations of IPs and FOIs by cluster of the TO5
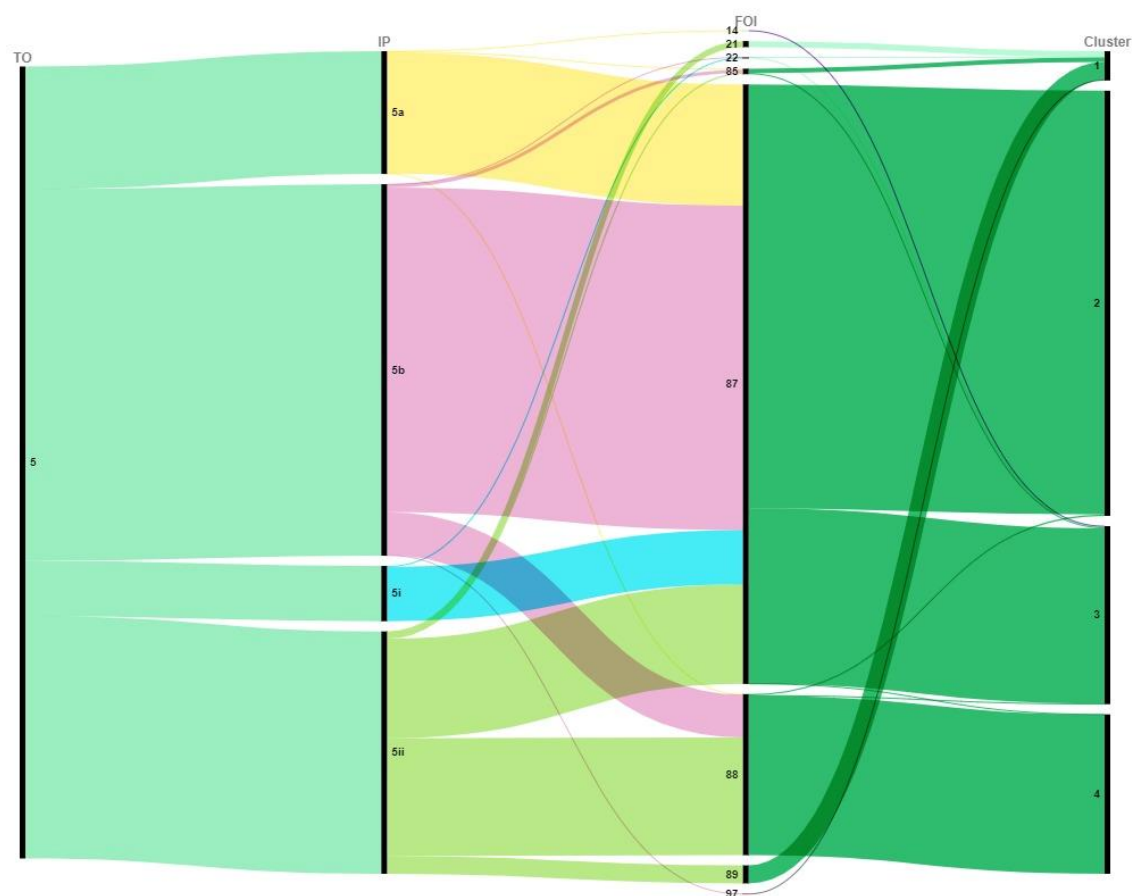
Source: Authors

Note: the alluvial diagram shows the number of clustered operations under TO5 and their distribution across the different IPs and FoIs. FoIs. Operations with multiple IPs and/or FoIs are counted multiple times.

The figures below show that investments to prevent climate-related risks (Cluster 2) and manage and mitigate climate change consequences (Cluster 3) account for 88% of the total number of operations and more than 82% of the total eligible expenditure allocated to TO5. Those of Cluster 3 also have a generally larger size than the others. Only 7% of the total allocation was instead devoted to managing non-climate related consequences and preventing risk (Cluster 4), although these investments covered 983 operations (19% of the total). Instead, generic environmental risk prevention investments under Cluster 1 (e.g., preventing industrial pollution, improving water management, and protecting biodiversity) represent only a residual portion of operations and total eligible expenditure allocated.

Figure 22:   Number of operations by typology clusters in TO5
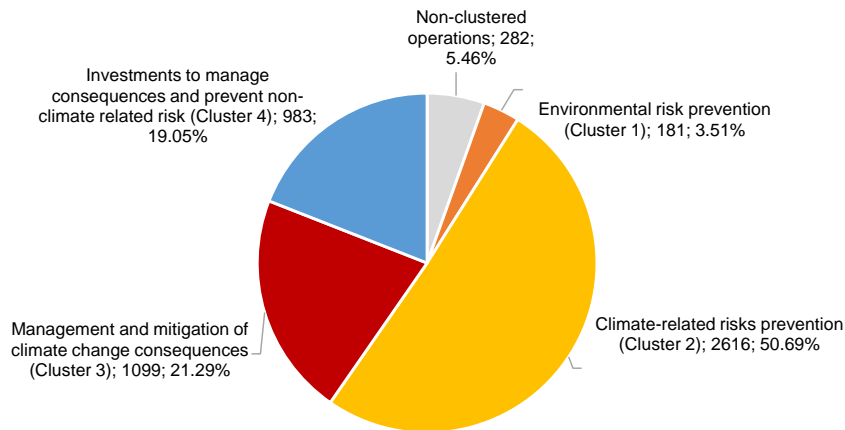
Source: Authors

Figure 23:   Percentage distribution of expenditure by typology clusters of TO5 (in billion EUR)
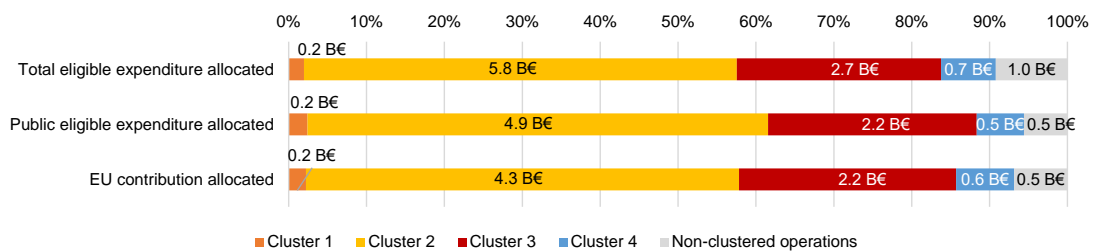
Legend: Cluster 1 - Environmental risk prevention, Cluster 2 - Climate-related risks prevention, Cluster 3 - Management and mitigation of climate change consequences, Cluster 4 - Investments to manage consequences and prevent non-climate related risk

Note: the total eligible expenditure allocated to clustered operations under TO5 amounts to EUR 10.5 billion, the eligible public expenditure to EUR 8.3 billion and the total EU allocation to EUR 7.8 billion. It should be noted that not for all operations financial data is available. The total eligible expenditure is available for 5,148 operations out of 5,161; the eligible public expenditure is available for 4,541 operations out of 5,161; the allocated EU contribution is available for 4,810 operations out of 5,161

Source: Authors

Figure 24:   Average total eligible, public eligible and EU allocated expenditure by cluster under TO5 (in thousand EUR)
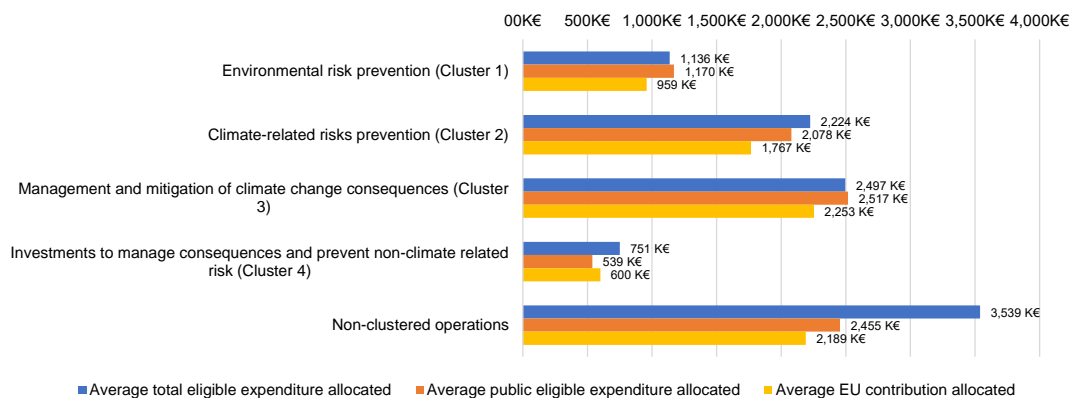
Source: Authors

In what follows, the emerging typology clusters are described. It should be noted that also in this case, there is a cluster pursuing multiple strategic objectives, namely Cluster 1. However, this cluster covers only 5% of the operations analysed and 9% of the total eligible expenditure allocated to the TO5.

2.2.5.1 Environmental risk prevention (Cluster 1)

In the context of TO5, **this cluster has a hybrid nature**, considering that it comprises operations that may have different strategic objectives. These are the most important:

- Rehabilitating industrial sites and contaminated land;
- Water management and conservation;
- Protecting and enhancing biodiversity.

The common thread of these different types of investments is the idea to prevent environmental risks, not necessarily linked to climate change.

2.2.5.2 Investments to prevent climate-related risks (Cluster 2)

The operations included under this cluster aim at **preventing the risks of climate change**. This means that they investigate the main risks of climate change and propose solutions to prevent or and reduce the risk and/or its consequences, such as erosion, fires, flooding, storms and drought. It should be noted that an analysis of a sample of operation descriptions showed that it is not always easy to determine whether operations aim to prevent climate change risks or rather attempt to mitigate its consequences.

2.2.5.3 Investments to manage and mitigate climate change consequences (Cluster 3)

Unlike Cluster 4, **this cluster clearly focuses on adapting and mitigating climate change rather than risk prevention**. Examples of implemented projects are constructing an emergency system in case of flooding, equipment supply following the natural disaster's materialisation, reconstruction of roads ruined by flooding or storms, etc.

2.2.5.4 Investments to manage consequences and prevent non-climate related risk (Cluster 4)

The operations of this cluster are partly similar to those of Cluster 2 and 3. The only difference is that **they prevent the risks and/or manage the consequences of phenomena that are not related to climate change**, such as earthquakes, technological accidents and other kinds of disasters that may impact the civil society or the environment. Among the projects, the following examples can be mentioned: construction of anti-seismic buildings, reconstruction of buildings ruined by earthquakes or the creation of specific technologies to measure the levels of radioactive substances in the water.

2.2.6 Typologies of operations under the Thematic Objective 6 'Preserving and protecting the environment and promoting resource efficiency'

Thematic Objective 6 funds operations whose overall objective is to preserve and protect the environment. To this end, different types of investments are mobilised: investments in the waste sector (IP 6a) or in the water sector (IP 6b), investments aimed at conserving, protecting the natural and cultural heritage (IP 6c) or biodiversity (IP 6d) or those aimed at improving the urban environment (IP 6e), promoting innovative technologies for the environment protection (IP 6f). Finally, operations under this TO may also support the industrial transition towards a resource-efficient economy (IP 6g).

The clustering activity focused on 31,069 operations out of the total of 33,262 operations falling under TO6 (i.e., 93.4%), thus covering almost 90% of the total eligible expenditure allocated to the operations under this TO (whose total allocation in terms of total eligible expenditure is equal to EUR 48.1 billion[29]).

As a result of the implementation of the k-means algorithm and the validation and revision of the clustering results, **a total of six different clusters were identified** based on the combination of IPs and FoIs, as shown in Figure 25: and summarised in the following table. See Annex I for more details on the average shares of all the IPs and FoIs characterising each cluster**Error! Reference source not found.Error! Reference source not found.**.

Table 6 –   List of clusters under TO6 and related predominant IPs and FoIs

Typology cluster	Top 1 IP	Top 3 FoIs
Cluster 1 - Waste management	▪ **6a** (99.8%) ▪ Other non-predominant IPs (0.2%)	▪ **017** - Household waste mgmt. (incl. minimise, sort, recycle ...): 85.27% ▪ **018** - Household waste mgmt (incl. Mech, Bio, thermal & landfill): 9.55% ▪ **019** - Commercial, industrial or hazardous waste management: 4.89% ▪ Other non-predominant FoIs: 0.28%
Cluster 2 - Water treatment and provision	▪ **6b** (100.00%)	▪ **022** - Wastewater treatment: 68.52% ▪ **020** - Water infrastructure for human consumption: 29.15% ▪ Other non-predominant FoIs: 2.33%
Cluster 3 - Water management and conservation	▪ **6b** (99.4%) ▪ Other non-predominant IPs (0.6%)	▪ **021** Water management & drinking water conservation: 99.76% ▪ Other non-predominant FoIs: 0.24%
Cluster 4 - Protecting and restoring biodiversity	▪ **6d** (99.4%) ▪ Other non-predominant IPs (0.6%)	▪ **085** - Biodiversity, nature protection & green infrastructure: 87.04% ▪ **086** - Protect, restorat & sustainable use of Natura 2000 sites: 10.06% ▪ Other non-predominant FoIs (2.9%)
Cluster 5 - Protecting, promoting and developing natural and cultural heritage	▪ **6c** (99.9%) ▪ Other non-predominant IPs (0.1%)	▪ **094** - Protect, develop & promote public cultural assets: 51.13% ▪ **091** - Develop & promote tourism potential of natural areas: 14.4% ▪ **093** - Development and promotion of public tourism services: 11.76% ▪ Other non-predominant FoIs: 22.71%
Cluster 6 - Urban regeneration	▪ **6e** (92.7%) ▪ Other non-predominant IPs (0.3%)	▪ **094** - Protect, develop & promote public cultural assets: 30.2% ▪ **083** - Air quality measures: 19.7% ▪ **089** - Rehabilitation of industrial sites and contaminated land: 18.7% ▪ Other non-predominant FoIs: 31.4%

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[29] Please note that the data on the total eligible expenditure is available for 33,188 operations out of 33,262.

Source: Authors

Figure 25:   Combinations of IPs and FOIs by cluster of the TO6
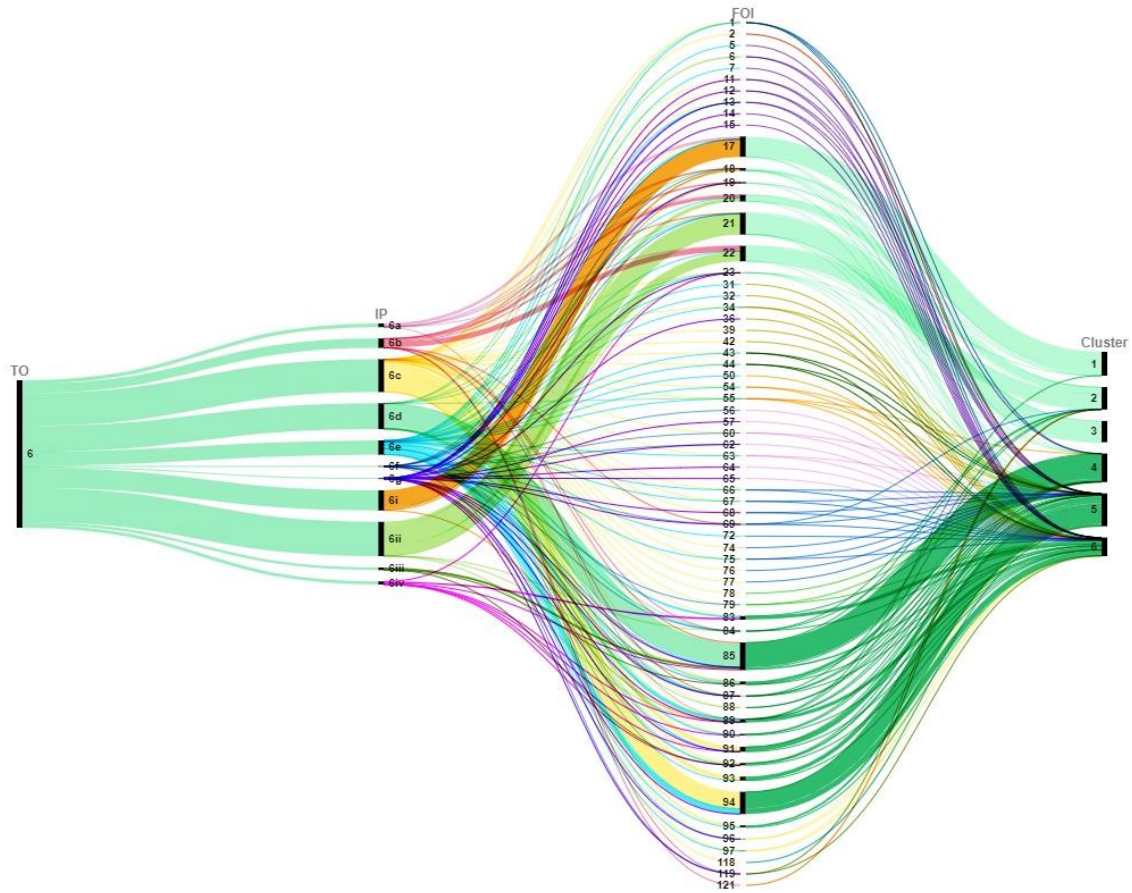
Source: Authors

Note: the alluvial diagram shows the number of clustered operations under TO6 and their distribution across the different IPs and FOIs. FOIs. Operations with multiple IPs and/or FOIs are counted multiple times.

Operations are almost equally distributed across the six clusters. Operations in the water sector (included in Cluster 2 and 3) represent nearly 30% of the total number of operations.

Figure 26:   Number of operations by typology clusters in TO6
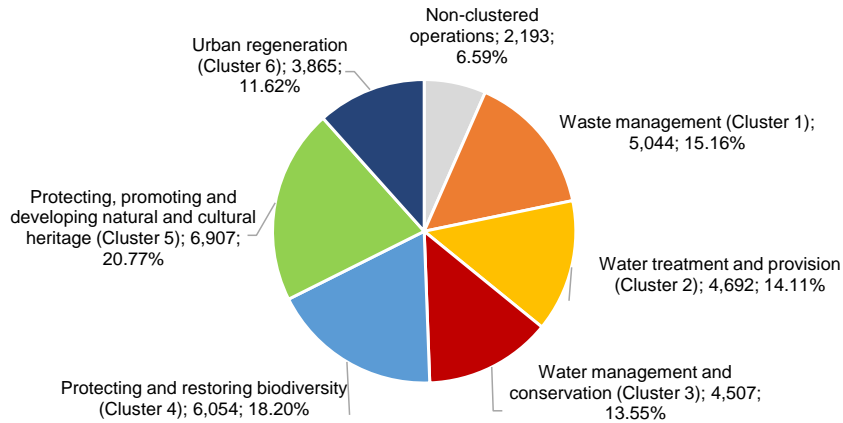
Source: Authors

The difference across clusters is higher when one looks at the distribution of the total expenditure. The cluster funding investments for water treatment and provision (Cluster 2) absorb more than 39% of the total eligible expenditure allocated to the analysed operations under TO6, which goes up to nearly 45% if one also considers the other cluster in the water sector (Cluster 3). Cluster 2 is also the one funding larger operations, on average.

Figure 27: **Percentage distribution of expenditure by typology clusters of TO6 (in billion EUR)**
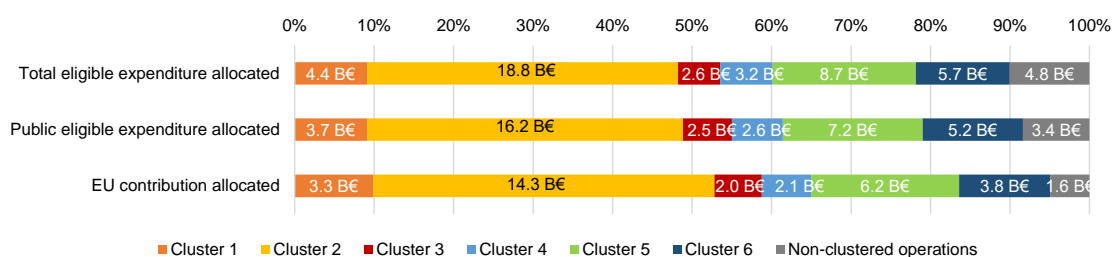
Legend: Cluster 1 - Waste management, Cluster 2 - Water treatment and provision, Cluster 3 - Water management and conservation, Cluster 4 - Protecting and restoring biodiversity, Cluster 5 - Protecting, promoting and developing natural and cultural heritage, Cluster 6 - Urban regeneration

Note: the total eligible expenditure allocated to clustered operations under TO6 amounts to EUR 48.1 billion, the eligible public expenditure to EUR 40.8 billion and the total EU allocation to EUR 33.3 billion. It should be noted that not for all operations financial data is available. The total eligible expenditure is available for 29,392 operations out of 33,262; the eligible public expenditure is available for 4,541 operations out of 33,262; the allocated EU contribution is available for 30,797 operations out of 33,262

Source: Authors

Figure 28: **Average total eligible, public eligible and EU allocated expenditure by cluster under TO6 (in thousand EUR)**
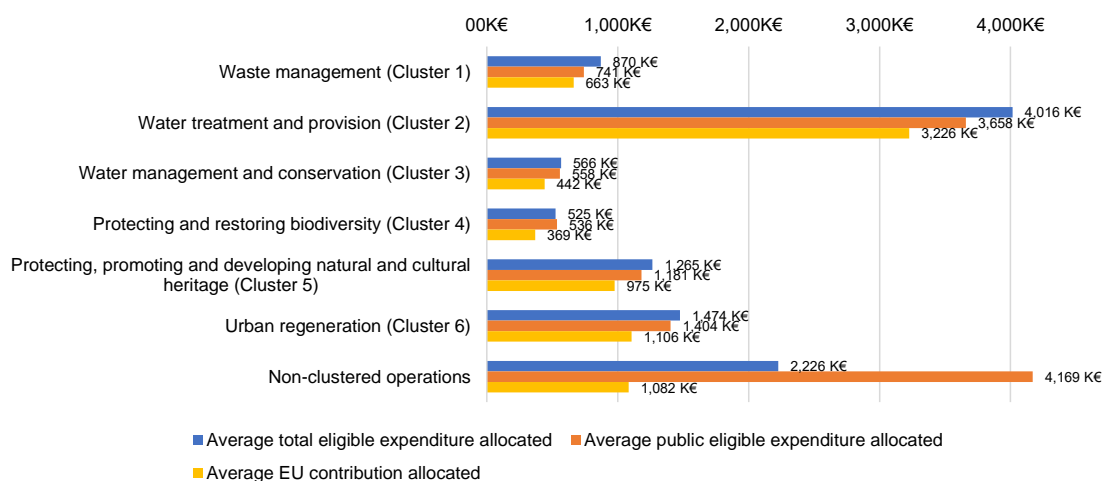
Source: Authors

In what follows, the emerging typology clusters are described. Similarly to the Thematic Objective 2, the clusters under this TO appear generally homogeneous regarding the overall strategic objective. Only cluster 6 has a more hybrid nature. It funds very different operations but with a general focus on urban regeneration.

2.2.6.1   Waste management (Cluster 1)

This cluster is focused on investments in the waste sector. Operations under this category relate to waste management, either in households or in the commercial and industrial sectors. For instance, they fund plants for collecting and/or processing waste or projects investigating how to minimise waste production.

It should be noted that there is one FoI not related to waste (i.e., FoI 020 'Provision of water for human consumption') that appear to be relevant in the cluster, although to a low extent (i.e., it represents only 0.02% of the average FoI share). From an in-depth analysis of such operations, it was clarified that they are related to investments in the waste sector and have therefore been correctly classified under this cluster.

2.2.6.2   Water treatment and supply (Cluster 2)

This cluster includes operations in the water sector. From an analysis of the predominant FoIs, it emerges that **operations under this cluster concern water treatment and the provision of water for human consumption**. For example, funded operations develop drinking water and sanitation infrastructure or wastewater collection and processing system, or they aim to increase the number of households with access to drinking water or secure water supply from both a quantitative and qualitative point of view.

As in the previous cluster, some FoIs seem to fund other types of operations, such as FoI 018 on waste management or FoI 085 on biodiversity protection. However, from an analysis of the operation descriptions, it is evident that operations classified under these fields focus on water treatment rather than the other themes.

2.2.6.3   Water management and conservation (Cluster 3)

This is another cluster funding operations in the water sector. Unlike the previous one, **this cluster focuses on water management and conservation** rather than its treatment and provision.

2.2.6.4   Protecting and restoring biodiversity (Cluster 4)

This is the only cluster under TO6 specifically aimed at protecting and restoring biodiversity. It includes operations whose common goal is to promote the conservation, preservation, and recovery of species and habitats and those in the Natura 2000 areas and the European network of nature protection areas. However, they fund activities directly improving the conservation of vegetable and animal species or restoring natural environments and ecological continuities and activities to raise the awareness of the population and its participation in the management, protection, and maintenance of protected natural spaces and biodiversity. This is done, for instance, by promoting environmental volunteering.

The cluster also includes some operations with a hybrid nature, whose FoI is 087 but the IP is 6d. They are operations aimed at protecting biodiversity, in line with the main strategic objective of this cluster and preventing climate-related risks. For instance, some projects actively implement climate protection measures by increasing the biological diversity of the green infrastructure.

2.2.6.5   Protecting, promoting and developing natural and cultural heritage (Cluster 5)

Operations under this cluster are instead devoted to promoting natural and cultural heritage. They may fund activities to improve the attractiveness of and

accessibility to natural or cultural areas of interest (e.g., through the renovation of cultural sites), especially those of tourist interest, and promote sustainable tourism.

2.2.6.6 Urban regeneration (Cluster 6)

Very different operations are funded under this cluster. There are operations aimed at regenerating and maintaining the urban environment and its environmental quality, others aimed at improving the air quality of cities and others to decontaminate polluted urban areas. **Despite having very different nature, these operations have the common strategic objective of enhancing and regenerating urban areas**.

2.2.7 Typologies of operations under the Thematic Objective 7 'Promoting sustainable transport and removing bottlenecks in key network infrastructures'

Thematic Objective 7 is focused on transport infrastructure, with a view on sustainable transport. More specifically, it funds operations that invest in the Trans-European Transport Network (TEN-T) (IP 7a and 7b), aim at developing and improving environmentally-friendly and low-carbon transport systems (7c) as well as rehabilitating comprehensive, high quality and interoperable railway systems, and promoting noise-reduction measures (IP 7d). Finally, there are also operations whose goal is to improve energy efficiency and security of supply (IP 7e).

The clustering activity focused on 3,770 operations out of the total of 4,067 operations falling under TO7 (i.e., 92.7%), thus covering 85.9% of the total eligible expenditure allocated to the operations under this TO (whose total allocation in terms of total eligible expenditure is equal to EUR 78.7 billion).

As a result of the implementation of the k-means algorithm and the validation and revision of the clustering results, **a total of six different clusters were identified** based on the combination of IPs and FoIs, as shown in Figure 29: and summarised in the following table. See Annex I for more details on the average shares of all the IPs and FoIs characterising each cluster**Error! Reference source not found.Error! Reference source not found.**.

Table 7 – List of clusters under TO7 and related predominant IPs and FoIs

Typology cluster	Top 1 IP	Top 3 FoIs
Cluster 1 - Multimodal transport in the TEN-T	**7a** (100.00%)	▪ **033** - TEN-T reconstructed or improved road: 24.3% ▪ **028** - TEN-T motorways and roads — core network (new build): 18.8% ▪ **024** - Railways (TEN-T Core): 17.3% ▪ Other non-predominant FoIs: 39.6%
Cluster 2 - Regional mobility for the improvement of the TEN-T	**7b** (100.00%)	▪ **030** - Secondary road links to TEN-T road network and nodes (new build): 38.7% ▪ **031** - Other national and regional roads (new build): 33.6% ▪ **026** - Other Railways: 9.4% ▪ Other non-predominant FoIs: 18.3%
Cluster 3 - Road infrastructure for the improvement of the TEN-T	**7b** (100.00%)	▪ **034** - Other reconstructed or improved roads (motorway, national, regional or local): 99.9% ▪ Other non-predominant FoIs: 0.1%
Cluster 4 - High quality and interoperable railway systems	**7d** (100.00%)	▪ **026** - Other Railways: 57.9% ▪ **025** - Railways (TEN-T comprehensive): 15.03% ▪ **024** - Railways (TEN-T Core): 12.9% ▪ Other non-predominant FoIs: 14.17%
Cluster 5 - Energy efficiency in transport	**7e** (100.00%)	▪ **005** - Electricity (storage and transmission): 54.6% ▪ **007** - Natural gas: 34.75% ▪ **008** - Natural gas (TEN-E): 7.8% ▪ Other non-predominant FoIs: 2.85%
Cluster 6 - Environmentally-friendly and low-carbon transport systems	**7c** (100.00%)	▪ **043** - Clean urban transport infrastructure & promotion: 20.3% ▪ **090** - Cycle tracks and footpaths: 14.3% ▪ **044** - Intelligent transport systems: 13.5% ▪ Other non-predominant FoIs: 51.9%

Source: Authors

Figure 29:   Combinations of IPs and FOIs by TO7 cluster
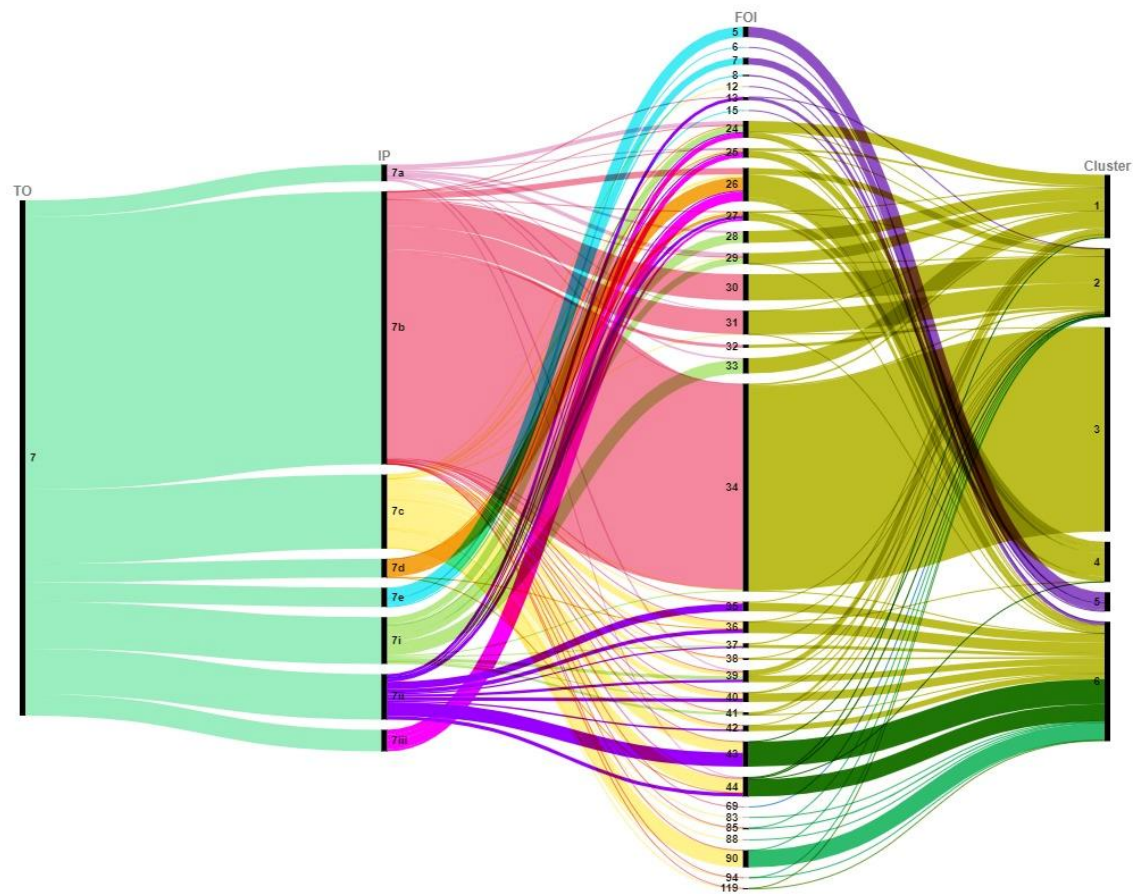
Source: Authors

Note: the alluvial diagram shows the number of clustered operations under TO7 and their distribution across the different IPs and FoIs. FoIs. Operations with multiple IPs and/or FoIs are counted multiple times.

The Figure below shows that the clusters focusing on developing the TEN-T infrastructure (Cluster 1, 2 and 3) cover the highest number of operations, more than 60% of the total. In contrast, the cluster aimed at improving energy efficiency in transport (Cluster 5) represents less than 4% of operations.

Figure 30:   Number of operations by typology clusters in TO7
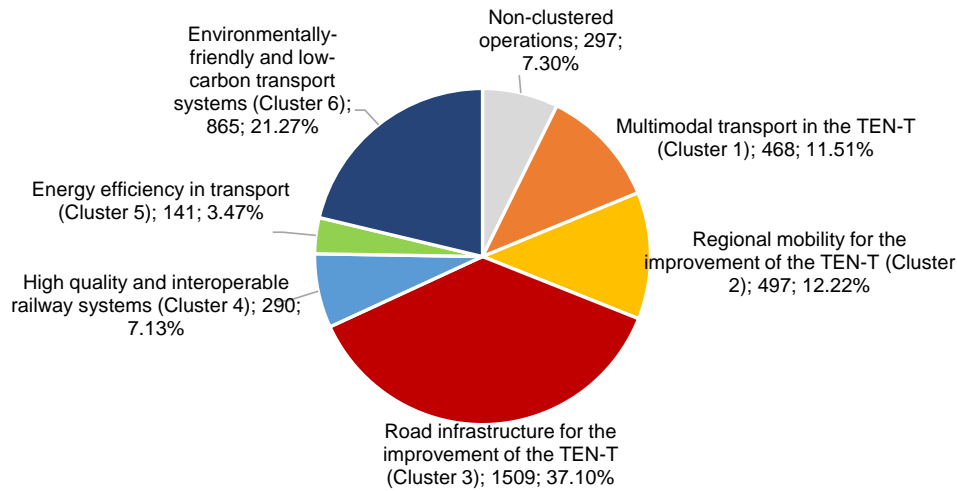
Source: Authors

A similar picture emerges when looking at the overall distribution of clusters in terms of allocated expenditure. Those focusing on developing the TEN-T infrastructure (Cluster 1, 2 and 3) still represent more than 60% of the total eligible expenditure allocated to the operations analysed. Operations under Cluster 1, in particular, are also of average larger size than those of the other clusters.

Figure 31:   Percentage distribution of expenditure by typology clusters of TO7 (in billion EUR)
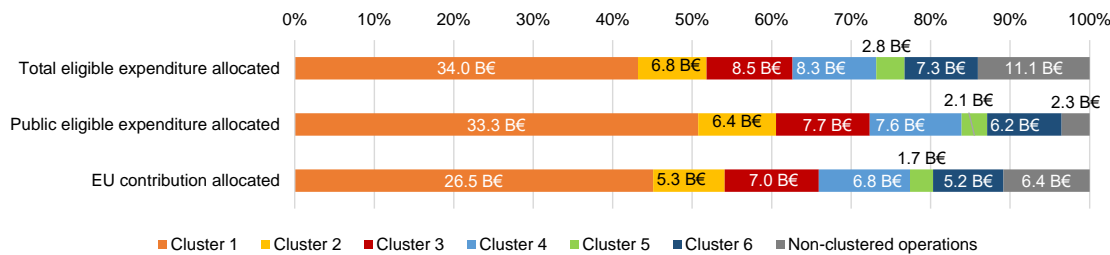
Legend: Cluster 1 - Multimodal transport in the TEN-T, Cluster 2 - Regional mobility for the improvement of the TEN-T, Cluster 3 - Road infrastructure for the improvement of the TEN-T, Cluster 4 - High quality and interoperable railway systems, Cluster 5 - Energy efficiency in transport, Cluster 6 - Environmentally-friendly and low-carbon transport systems

Note: the total eligible expenditure allocated to clustered operations under TO7 amounts to EUR 78.7 billion, the eligible public expenditure to EUR 65.6 billion and the total EU allocation to EUR 58.8 billion. It should be noted that not for all operations financial data is available. The total eligible expenditure is available for all operations, while the eligible public expenditure is available for 3,720 operations out of 4,067 and the allocated EU contribution is available for 3,814 operations out of 4,067

Source: Authors

Figure 32:   Average total eligible, public eligible and EU allocated expenditure by cluster under TO7 (in thousand EUR)
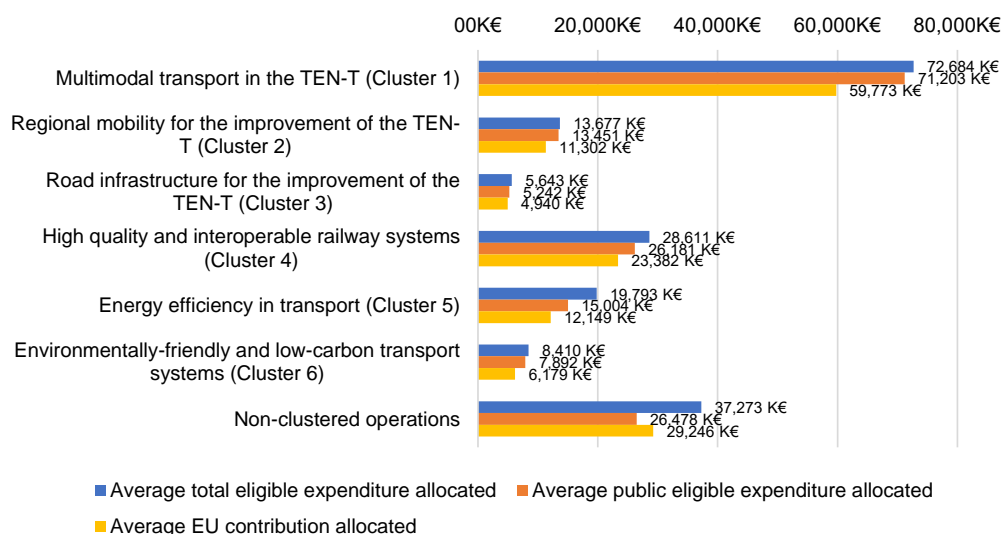
Source: Authors

In what follows, the different clusters identified are further described. While there are three sectoral clusters focused on specific types of transport infrastructure (multimodal transport with Cluster 1, road infrastructure with Cluster 3 and railways with Cluster 4), the other three clusters can be defined as 'thematic' as they focus on specific themes (regional mobility with Cluster 2, energy efficiency with Cluster 5 and environmental-friendly solutions with Cluster 6).

2.2.7.1   Multimodal transport in the TEN-T (Cluster 1)

Operations under this cluster fund transport investments aim to support multimodal transport through investments in long-distance roads, motorways and railways, and ports and airports serving primary nodes of the TEN-T. These investments may consist of the construction of transport infrastructure or the modernisation of the existing infrastructure, with the overall goal of improving mobility at the European level.

According to the FoI under which they are categorised (i.e., FoI 034), some operations seem to be not specifically related to the improvement of the TEN-T infrastructure (i.e., 13 operations out of 458). However, as from an analysis of their Specific Objective title, they are aimed to support the multimodal Single European Transport Area through the construction or modernisation mainly of roads and motorways.

2.2.7.2   Regional mobility for the improvement of the TEN-T (Cluster 2)

Under this cluster, **the focus is on regional mobility** more than on European mobility. **Still, the ultimate goal is to improve the TEN-T infrastructure** by connecting secondary and tertiary nodes. This is done by supporting the construction or renovation of national and regional roads or railways which are secondary or tertiary nodes of the TEN-T.

2.2.7.3 Road infrastructure for the improvement of the TEN-T (Cluster 3)

This cluster is very similar to Cluster 2. The only difference is that operations under **this cluster have a strong focus on road infrastructure specifically rather than regional mobility more in general**. They only aim to improve or reconstruct roads that are part of secondary and tertiary nodes to TEN-T infrastructure.

2.2.7.4 High quality and interoperable railway systems (Cluster 4)

This is another cluster whose focus is on the type of transport infrastructure. While the other clusters fund operations in all kinds of transport infrastructure, the main focal point of this cluster is railways and their systems. These operations may or may not be relevant for the TEN-T infrastructure, but they aim to construct, reconstruct or rehabilitate high-quality and interoperable national and regional railways. In some cases, their goal is also to promote noise-reduction measures as far as possible.

2.2.7.5 Energy efficiency in transport (Cluster 5)

This is another cluster with a horizontal focus on all types of transport infrastructure. **Its strategic objective is to improve energy efficiency and security of supply**, for instance, through the development of smart energy distribution, storage and transmission systems and the integration of distributed generation from renewable sources. Among the sample of projects, some modernise the natural gas transmission system through smart technology; others install software to increase the prompt and reliability of the information on the natural gas transmission system.

2.2.7.6 Environmentally-friendly and low-carbon transport systems (Cluster 6)

Despite funding very different activities (e.g., construction or modernisation of infrastructure, purchase of equipment, feasibility studies for alternative solutions environmentally friendly, etc.), **operations under this cluster have the common goal of developing and improving environmentally-friendly (including low-noise) and low-carbon transport systems in all types of transport infrastructure**.

2.2.8 Typologies of operations under the Thematic Objective 8 'Promoting sustainable and quality employment and supporting labour mobility'

Operations under Thematic Objective 8 promote sustainable and quality employment and support labour mobility. More specifically, some support the development of business incubators and investment support for self-employment, micro-enterprises and business creation (IP 8a), others employment-friendly growth, for instance, by converting declining industrial regions and enhancement of accessibility to, and development of, specific natural and cultural resources (IP 8b). Some operations promote local initiatives to provide services to create jobs (IP 8c), and others invest in infrastructure for employment services (IP 8d). Cross-border operations also promote sustainable and quality employment and support labour mobility by integrating cross-border labour markets, including cross-border mobility, joint local employment initiatives, information and advisory services and joint training (IP 8e).

The clustering activity focused on 4,887 operations out of the total of 5,740 operations falling under TO8 (i.e., 85.1%), but covering 66.1% of the total eligible expenditure allocated to the operations under this TO (whose total allocation in terms of total eligible expenditure is equal to EUR 4.07 billion[30]).

As a result of the implementation of the k-means algorithm and the validation and revision of the clustering results, **a total of six different clusters were identified** based on the combination of IPs and FoIs, as shown in Figure 33: and summarised in the following table. See Annex I for more details on the average shares of all the IPs and FoIs characterising each cluster**Error! Reference source not found.Error! Reference source not found.**.

Table 8 – List of clusters under TO8 and related predominant IPs and FoIs

Typology cluster	Top 1 IP	Top 3 FoIs
Cluster 1 - Business incubators	▪ **8a** (99.9%) ▪ Other non-predominant IPs (0.1%)	▪ **067** – SME business development, entrepreneurship & incubation: 87.2% ▪ **104** - Self-employment, entrepreneurship & business creation: 9.3% ▪ **073** - Support to social enterprises (SMEs): 1.4% ▪ Other non-predominant FoIs: 2.1%
Cluster 2 - Employment-friendly growth exploiting cultural sector and tourism	**8b** (100%)	▪ **091** - Develop & promote tourism potential of natural areas: 18.6% ▪ **076** - Dev. & promotion of cultural & creative assets in SMEs: 18.5% ▪ **094**: Protect, develop & promote public cultural assets: 17% ▪ Other non-predominant FoIs: 45.9%
Cluster 3 - Social infrastructure for regional and local development	▪ **8b** (99.6%) ▪ Other non-predominant IPs (0.4%)	▪ **055** – Other social infrastructure: 100%
Cluster 4 - Quality employment and labour mobility	▪ **8e** (96%) ▪ Other non-predominant IPs (4%)	▪ **102** - Access to employment & labour mobility: 21% ▪ **108** - Modernisation of labour market institutions: 20.9% ▪ **118** - Strengthening vocational education & training: 13.6% ▪ Other non-predominant FoIs: 44.5%
Cluster 5 - Infrastructure for early childhood education and care	▪ **8b** (82%) ▪ Other non-predominant IPs (18%)	▪ **052** – Infrastructure for early childhood education and care: 100%

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[30] Please note that the data on the total eligible expenditure is available for 5,730 operations out of 5,740.

| Cluster 6 - Development of industrial sites | 8b (100%) | ▪ 072 – Business infra. for SMEs (incl. industrial parks & sites): 100% |

Source: Authors

Figure 33: Combinations of IPs and FOIs by cluster of the TO8
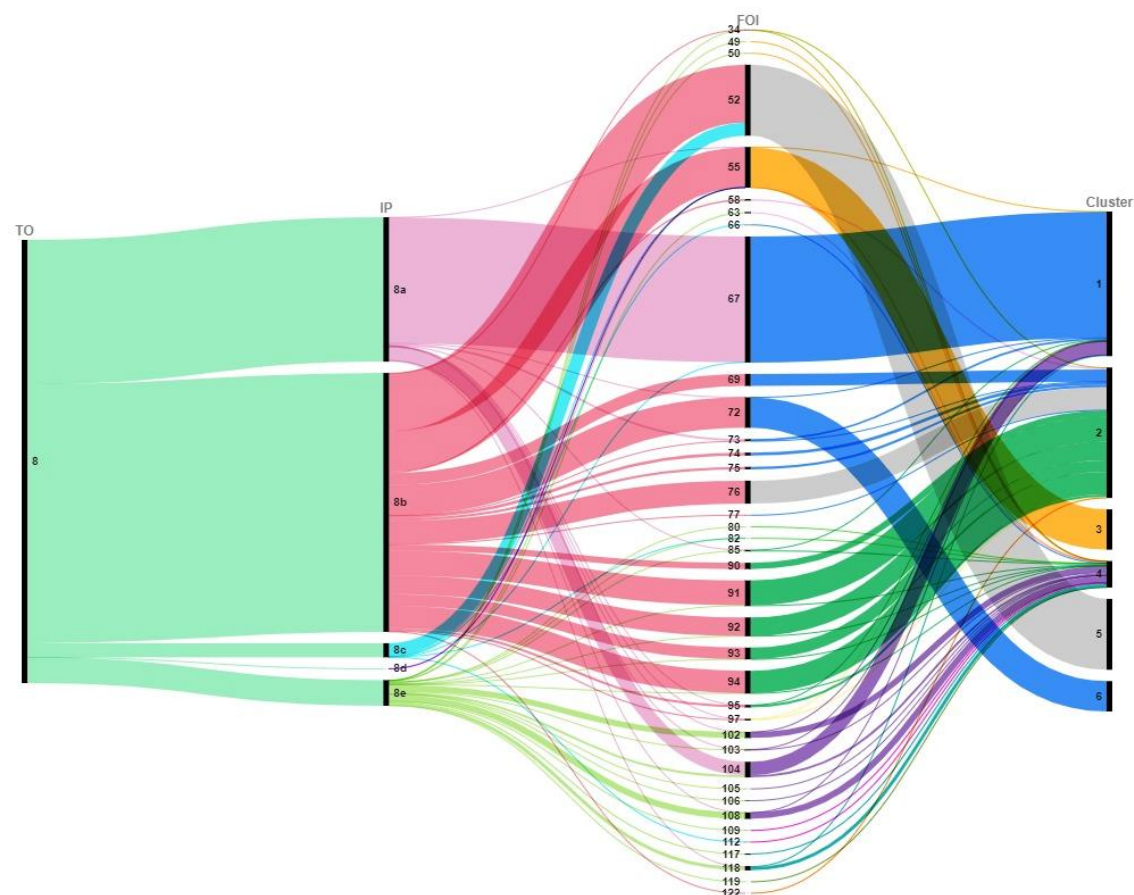
Source: Authors

Note: the alluvial diagram shows the number of clustered operations under TO8 and their distribution across the different IPs and FoIs. FoIs. Operations with multiple IPs and/or FoIs are counted multiple times.

The highest number of operations is in the cluster supporting the development of business incubators (Cluster 1) and in the cluster supporting employment growth by investing in the cultural sector and tourism potential of territories (Cluster 2). Generic support to quality employment and labour mobility (Cluster 4) is less significant in terms of the number of operations.

Figure 34:   Number of operations by typology clusters in TO8
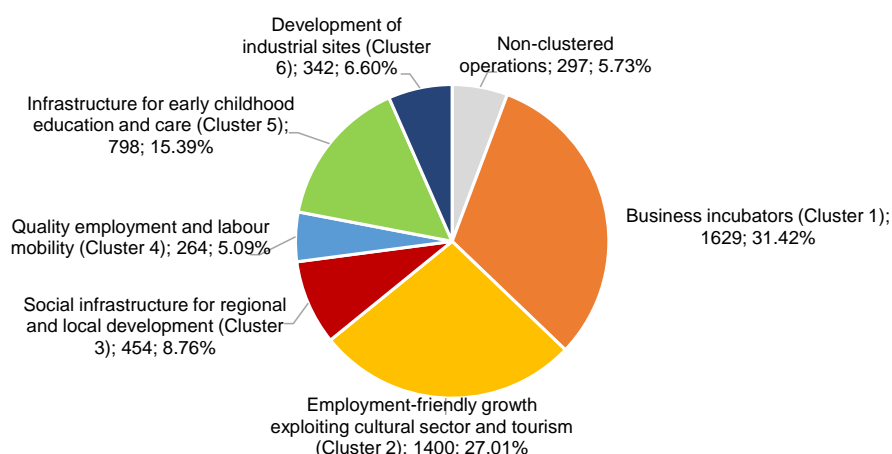
Source: Authors

The distribution of financial expenditure tells a slightly different story. The cluster supporting employment growth by investing in the culture and tourism potential of territories (Cluster 2) absorbs the highest amount of total eligible expenditure, despite covering only less than 9% of the total number of operations. Instead, the cluster promoting business incubators (Cluster 1) covers only a small amount of the total eligible expenditure. The lowest amount is allocated to developing industrial sites to support employment growth (Cluster 6).

**Figure 35:   Percentage distribution of expenditure by typology clusters of TO8
(in billion EUR)**
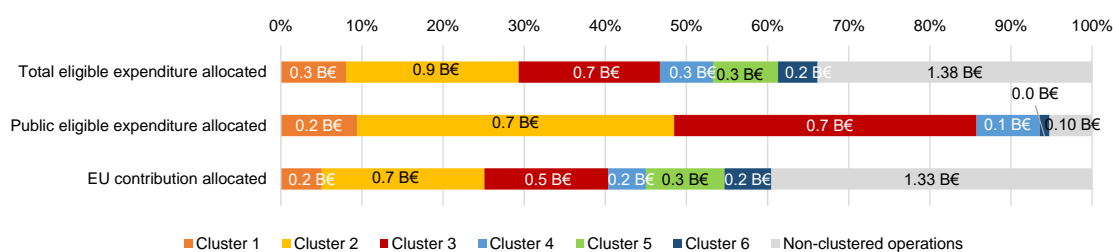
Legend: Cluster 1 - Business incubators, Cluster 2 - Employment-friendly growth exploiting cultural sector and tourism, Cluster 3 - Social infrastructure for regional and local development, Cluster 4 - Quality employment and labour mobility, Cluster 5 - Infrastructure for early childhood education and care, Cluster 6 - Development of industrial sites

Note: the total eligible expenditure allocated to clustered operations under TO8 amounts to EUR 4.07 billion, the eligible public expenditure to EUR 1.8 billion and the total EU allocation to EUR 3.3 billion. It should be noted that not for all operations financial data is available. The total eligible expenditure is available 5,730 operations out of 5,740; the public eligible expenditure is available for 3,678 operations out of 5,740; the allocated EU contribution is available for 5,707 operations out of 5,740

Source: Authors

When looking at the average size of operations, Cluster 3, devoted to promoting social infrastructure, funds larger operations on average, while Cluster 1 promoting business incubators funds operations with a relatively smaller size.

Figure 36: **Average total eligible, public eligible and EU allocated expenditure by cluster under TO8 (in thousand EUR)**
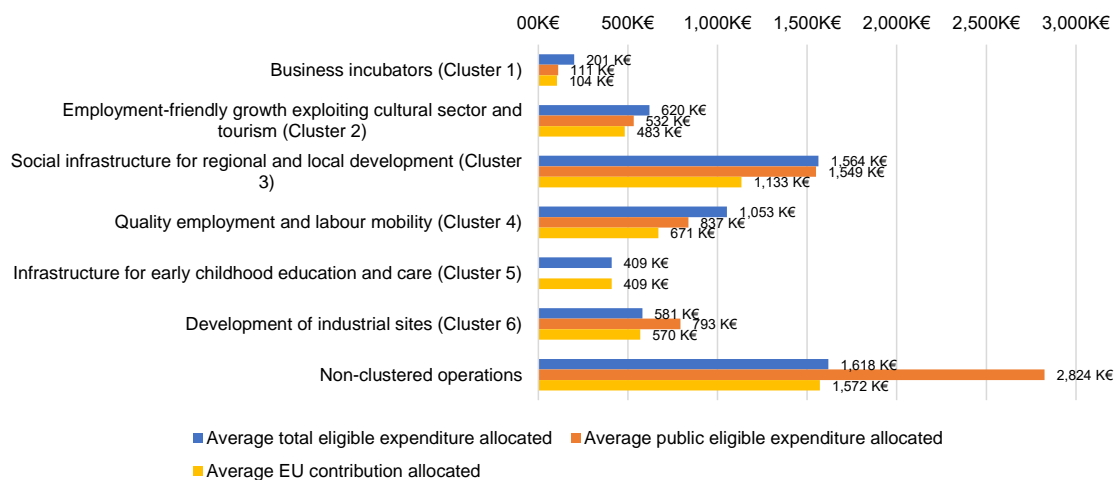
Source: Authors

In what follows, the different clusters emerging are further described. It should be noted that two clusters share some similarities with two clusters already identified under TO3. Instead, all the others clearly focus on improving employment growth, although by different means.

2.2.8.1 Business incubators (Cluster 1)

This cluster ultimately aims **to promote entrepreneurship, especially self-employment and the creation of micro-enterprises**. In some way, it shares some similarities with two clusters that emerged under TO3, namely the one focused on business creation and consolidation (Cluster 1) and the one supporting entrepreneurship and incubation (Cluster 2). The main difference is that its ultimate objective is to support sustainable and quality employment rather than creating and developing new enterprises.

2.2.8.2 Employment-friendly growth exploiting cultural sector and tourism (Cluster 2)

Operations under this cluster are generally devoted to developing, promoting, and protecting the natural, cultural and heritage assets to enhance the tourism potential of territories and favour employment. Therefore, cultural heritage, tourism, and employment are the three focal points of this cluster. Examples of projects are the recovery of sites of cultural value or the requalification of urban areas with tourism potential. All activities are expected to contribute to job creation.

2.2.8.3 Social infrastructure for regional and local development (Cluster 3)

Operations under this cluster are aimed to develop social infrastructure which contributes to regional and local development in general and employment in particular. Examples of projects are constructing public infrastructure providing social services, carrying out cultural activities, and public rest and leisure.

2.2.8.4 Quality employment and labour mobility (Cluster 4)

This is the only cluster aiming to promote labour mobility and improve the matching of labour market needs beyond favouring employment growth. It includes operations that are typically implemented by cross-border programmes. Operations under this cluster may, for instance, invest in tools that provide information about the labour market and the potential economic sector for labour mobility and profiles of the most attractive enterprises that can invest in new job positions. Others may organise interdisciplinary training programmes for higher education professionals to favour cross-border mobility in countries with a lack of professionals in specific fields.

2.2.8.5 Infrastructure for early childhood education and care (Cluster 5)

This cluster includes only operations under the Hungarian OP Territorial and settlement Development (2014HU16M2OP001). These operations aim to support **mainly female employment by providing public services to develop family-friendly and work-related institutions**. They mainly fund early childhood education and care infrastructures, such as kindergartens and nurseries.

2.2.8.6 Development of industrial sites for employment (Cluster 6)

The cluster funds Estonian and Hungarian operations to develop industrial sites and technology parks to ultimately promote employment in the concerned areas. Operations may fund either tangible and intangible investments that have a two-fold objective: first, to improve the competitiveness of the local economy by supporting a specific industrial site and second, to favour and secure existing employment.

2.2.9 Typologies of operations under the Thematic Objective 9 'Promoting social inclusion, combating poverty and any discrimination'

Operations under Thematic Objective 9 promote social inclusion by combating poverty and any forms of discrimination. Social inclusion may take different forms: there are operations aimed at reducing inequalities in terms of health status or improving access to social, cultural and recreational services (IP 9a), others at regenerating deprived communities (IP 9b) or supporting social enterprises (IP 9c). In some cases, social inclusion is also promoted by investing in community-led local development strategies (IP 9d). Cross-border operations, instead, support social inclusion more in general by favouring the integration of communities across borders (IP 9e).

The clustering activity focused on 20,220 operations out of the total of 20,632 operations falling under TO9 (i.e., 98%), thus covering 95.5% of the total eligible expenditure allocated to the operations under this TO (whose total allocation in terms of total eligible expenditure is equal to EUR 16.9 billion [31]).

As a result of the implementation of the k-means algorithm and the validation and revision of the clustering results, **a total of five different clusters were identified** based on the combination of IPs and FoIs, as shown in Figure 37: and summarised in the following table. See Annex I for more details on the average shares of all the IPs and FoIs characterising each cluster**Error! Reference source not found.Error! Reference source not found.**.

Table 9 –   List of clusters under TO9 and related predominant IPs and FoIs

Typology cluster	Top 1 IP	Top 3 FoIs
Cluster 1 - Health infrastructure	▪ **9a** (99.6%) ▪ Other non-predominant IPs (0.4%)	▪ **053** - Health infrastructure: 99.8% ▪ Other non-predominant FoIs: 0.2%
Cluster 2 - Other social infrastructure	▪ **9a** (100.00%)	▪ **055** - Other social infrastructure: 75.4% ▪ **054** - Housing infrastructure: 12.3% ▪ **052** - Infrastructure for early childhood education and care: 7.7% ▪ Other non-predominant FoIs: 4.6%
Cluster 3 - Regeneration of deprived communities	▪ **9b** (85.50%) ▪ Other non-predominant IPs (0.43%)	▪ **054** - Housing infrastructure: 32.3% ▪ **067** - SME business development, entrepreneurship & incubation: 10.1% ▪ **052** - Infrastructure for early childhood education and care: 8.6% ▪ Other non-predominant FoIs: 49%
Cluster 4 - Social infrastructure in deprived communities	▪ **9b** (87.8%) ▪ Other non-predominant IPs (12.2%)	▪ **055** - Other social infrastructure: 99.7% ▪ Other non-predominant FoIs: 0.3%
Cluster 5 - Community-led development initiatives for social inclusion	▪ **9d** (99.9%) ▪ Other non-predominant IPs (0.1%)	▪ **097** - Community-led local development strategies (ERDF): 79.6% ▪ **051** - Education infrastructure for primary & gen. Secondary:16.6% ▪ **087** - Adapt to climate change & prevent & manage climate risks: 3.06% ▪ Other non-predominant FoIs: 0.74%

Source: Authors

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[31] Please note that the data on the total eligible expenditure is available for 20,599 operations out of 20,632.

Figure 37:   Combinations of IPs and FOIs by cluster of the TO9
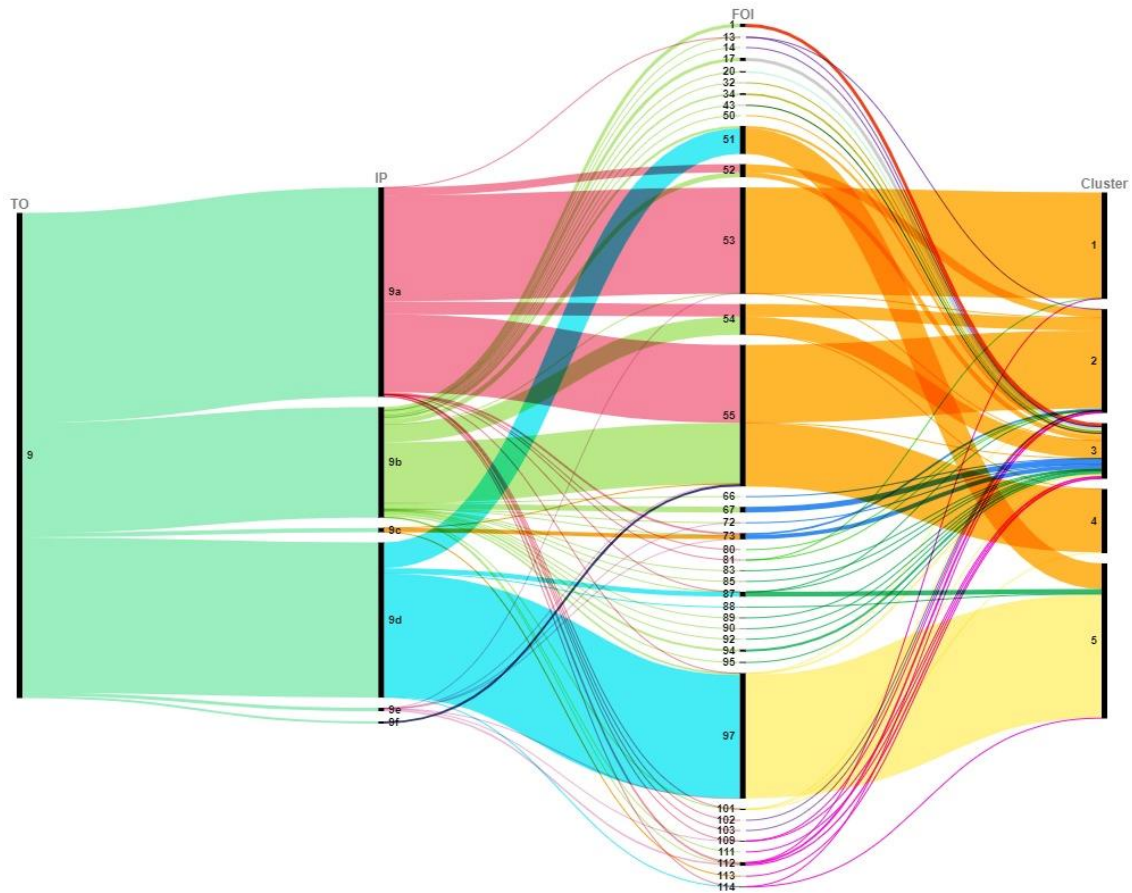
Source: Authors

Note: the alluvial diagram shows the number of clustered operations under TO9 and their distribution across the different IPs and FoIs. FoIs. Operations with multiple IPs and/or FoIs are counted multiple times.

31.5% of the operations are concentrated in the cluster providing generic support to community-led development initiatives aimed to foster social inclusion (Cluster 5). Around 40% are almost equally distributed between the cluster funding health infrastructure (Cluster 1) and other social infrastructure (Cluster 2). A comparative lower number of operations were funded under the clusters focusing on deprived communities (Cluster 3 and 4).

Figure 38:   Number of operations by typology clusters in TO9

Source: Authors

Operations funding health infrastructure (Cluster 1) are indeed those absorbing the highest percentage of the total eligible expenditure allocated to the analysed operations under TO9. At the same time, operations supporting community-led development by investing in education infrastructure (Cluster 5) are confirmed as the less significant, with only 4.1% of the total expenditure.

**Figure 39:   Percentage distribution of expenditure by typology clusters of TO9
(in billion EUR)**
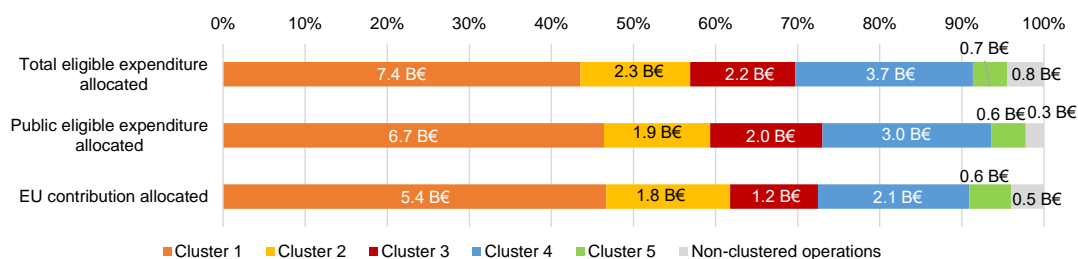
Legend: Cluster 1 - Health infrastructure, Cluster 2 - Other social infrastructure, Cluster 3 - Regeneration of deprived communities, Cluster 4 - Social infrastructure in deprived communities, Cluster 5 - Community-led development initiatives for social inclusion

Note: the total eligible expenditure allocated to clustered operations under TO9 amounts to EUR 16.9 billion, the eligible public expenditure to EUR 14.4 billion and the total EU allocation to EUR 11.6 billion. It should be noted that not for all operations financial data is available. The total eligible expenditure is available 20,599 operations out of 20,632; the eligible public expenditure is available for 18,622 operations out of 20,632; the allocated EU contribution is available for 18,468 operations out of 20,632

Source: Authors

Operations funding health infrastructure (Cluster 1) are also those having the average larger size, as those providing investments in other social infrastructure in deprived communities (Cluster 4). Those supporting community-led development (Cluster 5) are, on average, those having a smaller size.

Figure 40:   Average total eligible, public eligible and EU allocated expenditure by cluster under TO9 (in thousand EUR)
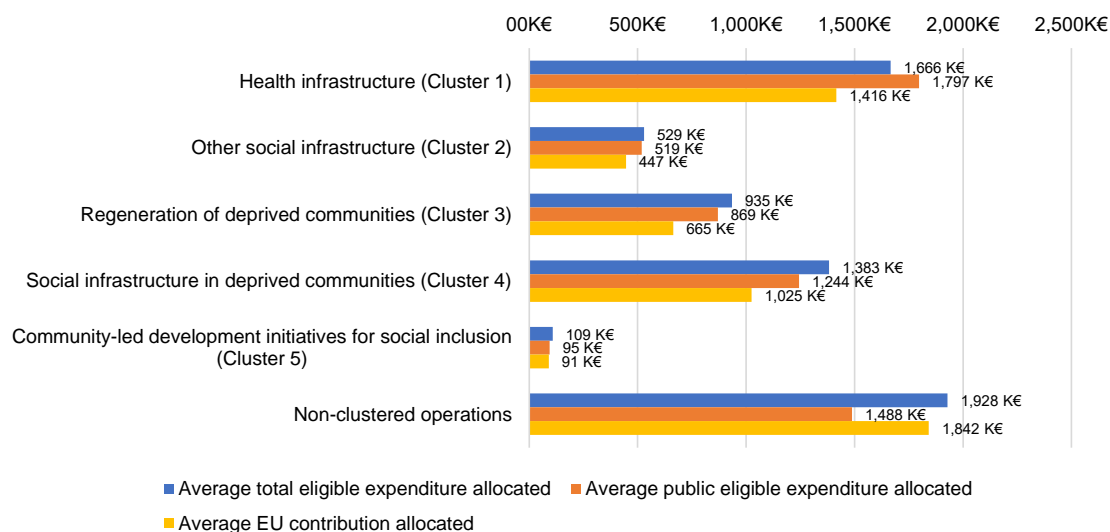
Source: Authors

In what follows, the different clusters identified by the k-means algorithm are presented. While some clusters are more generic and may be further broken down, others are very specific, even of some OPs, and their aggregation with other categories should therefore be explored.

2.2.9.1   Health infrastructure (Cluster 1)

This is a very specific cluster funding operations whose aim is to reduce inequalities in terms of health status. This is done by funding health infrastructure, such as improving primary and urgent access to affordable, sustainable and high-quality services, renovating existing hospital and medical centres, developing a sanitary and social offer for fragile populations, and purchasing advanced technologies in the health sector. Some residual operations aim to increase ICT solutions to address the healthy active ageing challenge and e-Health services and applications (including e-Care and ambient assisted living).

2.2.9.2   Other social infrastructure (Cluster 2)

This is another cluster that has a high focus on a unique strategic objective. Instead of investments in health infrastructure, **the focus is on infrastructures providing other social services, such as housing, culture and education**. Examples of projects are the promotion of access to schools, the realisation of social centres, the rehabilitation of ex-industrial sites and their transformation in cultural exhibitions or the adaption of apartments of people with special needs in consideration of the needs of their disability.

2.2.9.3   Regeneration of deprived communities (Cluster 3)

This hybrid cluster includes very different activities, ranging from supporting housing or education infrastructure to supporting SME development or social enterprises. However, there does appear to be a common thread between all these different types of operations, which is the support for physical, economic and social regeneration of deprived communities.

2.2.9.4   Social infrastructure in deprived communities (Cluster 4)

This very specific cluster has something in common both with the cluster investing in social infrastructure (Cluster 2) and the cluster providing generic support for the regeneration of deprived communities (Cluster 3). Operations under this cluster fund **projects supporting social infrastructures, but only in deprived areas**.

2.2.9.5   Community-led development initiatives for social inclusion (Cluster 5)

Operations under this cluster implement community-led local initiatives in urban and rural areas, whose ultimate aim is to favour social inclusion. These operations are implemented following a top-down approach: local people are involved in these development projects. They use resources in the area to address local challenges.

2.2.10 Typologies of operations under the Thematic Objective 10 'Investing in education, training and vocational training for skills and lifelong learning by developing education and training infrastructure'

Operations under Thematic Objective 10 support investments in education, training and vocational training[32]. While under TO9, education infrastructure was supported with the aim to improve social inclusion and accessibility, under TO10, the objective is to improve skills and lifelong learning by developing education and training infrastructure.

The clustering activity focused on 35,379 operations out of the total of 35,478 operations falling under TO10 (i.e., 99.7%), but covering 97.7% of the total eligible expenditure allocated to the operations under this TO (whose total allocation in terms of total eligible expenditure is equal to EUR 9.6 billion[33]).

As a result of the implementation of the k-means algorithm and the validation and revision of the clustering results, **a total of four different clusters were identified** based on the combination of IPs and FoIs, as shown in Figure 41: and summarised in the following table. See Annex I for more details on the average shares of all the IPs and FoIs characterising each cluster**Error! Reference source not found.Error! Reference source not found.**.

Table 10 – **List of clusters under TO10 and related predominant IPs and FoIs**

Typology cluster	Top 1 IP	Top 3 FoIs
Cluster 1 - Infrastructure for early childhood education and care	▪ **10a** (100%)	▪ **052** - Infrastructure for early childhood education and care: 99.95% ▪ Other non-predominant FoIs: 0.05%
Cluster 2 - Infrastructure for primary and secondary education	▪ **10a** (99.98%) ▪ Other non-predominant IPs (0.02%)	▪ **051** - Education infrastructure for primary & gen. Secondary: 98.3% ▪ Other non-predominant FoIs: 1.7%
Cluster 3 - Investments for vocational and tertiary education	▪ **10a** (84%) ▪ Other non-predominant IPs (16%)	▪ **050** - Education infrastructure for VET & adult learning: 53.6% ▪ **049** - Education infrastructure for tertiary education: 25.8% ▪ **118** - Strengthening vocational education & training: 10.3% ▪ Other non-predominant FoIs: 10.3%
Cluster 4 – Promotion of e-Leaning, e-Education and digital literacy	▪ **10a** (100%)	▪ **080** – e-Inclusion, e-Accessibility, e-Learning & e-Education: 100%

Source: Authors

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[32] IP 10a for OPs and 10b for cross-border programmes.

[33] Please note that the data on the total eligible expenditure is available for 35,477 operations out of 35,478.

Figure 41:   Combinations of IPs and FOIs by TO10 cluster
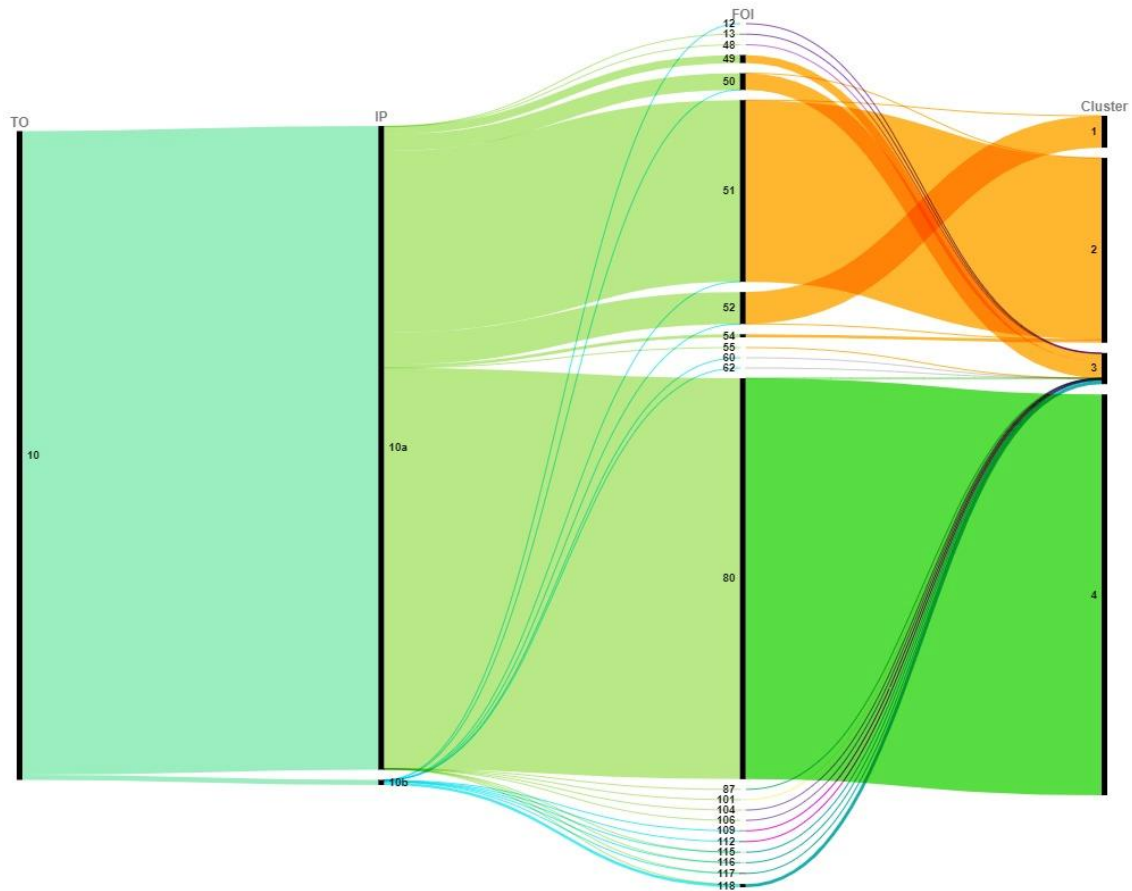
Source: Authors

Note: the alluvial diagram shows the number of clustered operations under TO10 and their distribution across the different IPs and FoIs. FoIs. Operations with multiple IPs and/or FoIs are counted multiple times.

More than 61% of the total number of operations were devoted to promoting e-Learning, e-Education and digital literacy (Cluster 4), while only 4.9% and 4.8% consist of infrastructure investments for early childhood education and care (Cluster 1) and vocational and tertiary education (Cluster 3).

Figure 42:   Number of operations by typology clusters in TO10
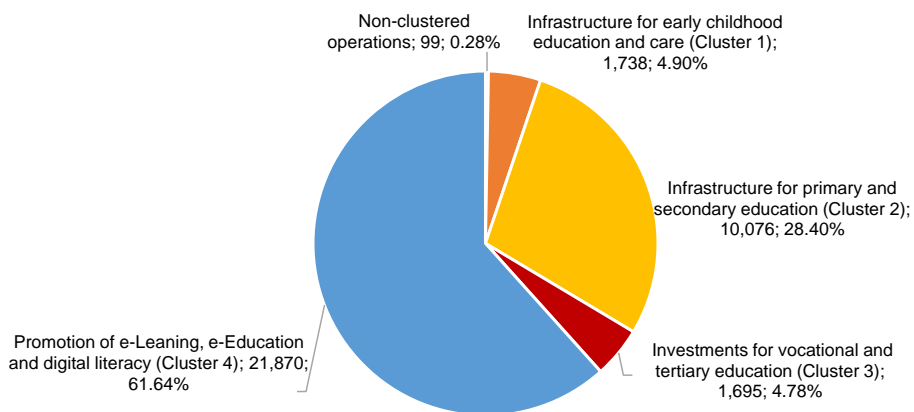
Source: Authors

A completely different picture emerges when analysing the financial distribution of the total eligible expenditure and its average amount. The cluster with the highest number of operations (Cluster 4) is, in fact, the one receiving the lowest amount of expenditure. In contrast, the cluster investing in infrastructure for primary and secondary education (Cluster 2) receives the highest amount of allocated expenditure.

Figure 43:   Percentage distribution of expenditure by typology clusters of TO10 (in billion EUR)
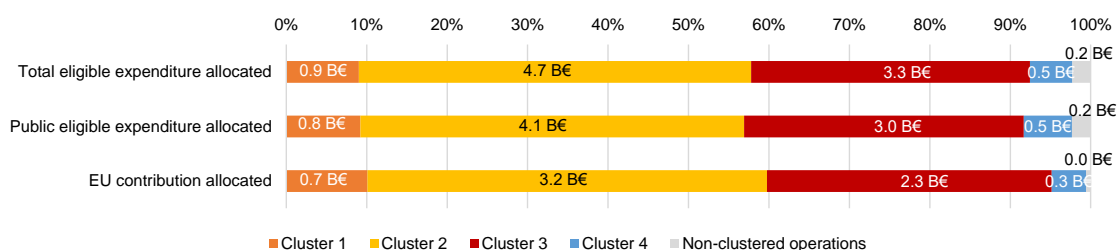
Legend: Cluster 1 - Infrastructure for early childhood education and care, Cluster 2 - Infrastructure for primary and secondary education, Cluster 3 - Investments for vocational and tertiary education, Cluster 4 – Promotion of e-Leaning, e-Education and digital literacy

Note: the total eligible expenditure allocated to clustered operations under TO10 amounts to EUR 9.6 billion, the eligible public expenditure to EUR 8.5 billion and the total EU allocation to EUR 6.5 billion. It should be noted that not for all operations financial data is available. The total eligible expenditure is available 35,477 operations out of 35,478; the eligible public expenditure is available for 34,586 operations out of 35,478; the allocated EU contribution is available for 34,399 operations out of 35,478

Source: Authors

Operations funding investments for vocational and tertiary education represents those with the average largest size (Cluster 3).

Figure 44:   Average total eligible, public eligible and EU allocated expenditure by cluster under TO10 (in thousand EUR)
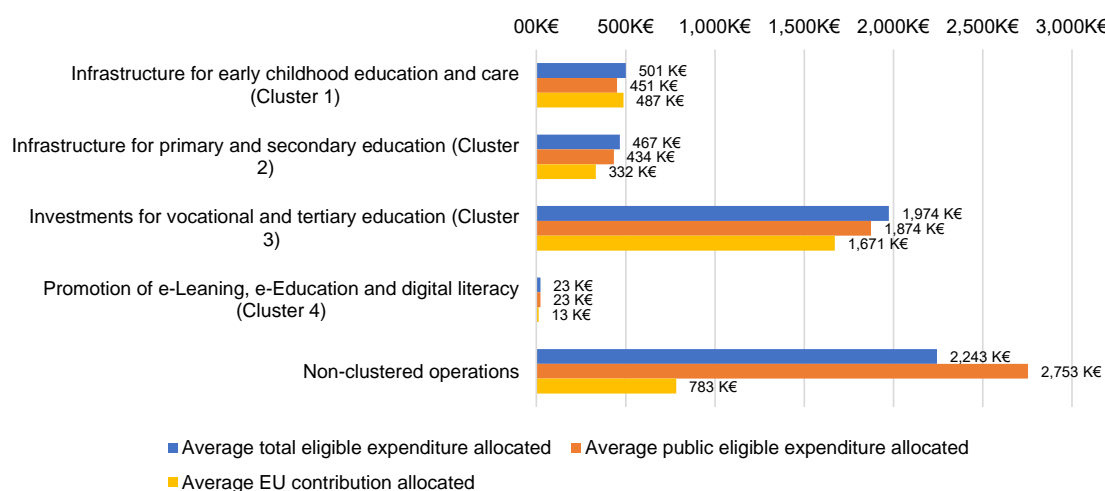
Source: Authors

In what follows, the different clusters identified are described more in detail. It should be noted that what characterises these clusters is not the Investment Priority, which is unique for all of them, but rather the Fields of Intervention.

2.2.10.1 Infrastructure for early childhood education and care (Cluster 1)

Operations under this cluster fund infrastructure investments for early childhood education and care. They thus consist of the construction or renovation of nurseries and kindergartens to improve their supply and learning conditions.

2.2.10.2 Infrastructure for primary and secondary education (Cluster 2)

Under this cluster, **investments are devoted to building or renovating existing infrastructure for primary and secondary education**. Examples of projects are the purchase of modern learning tools or equipment necessary for carrying out specific activities (such as art or music), improving the conditions of recreational or sporting spaces, etc. Some operations also aim to make schools and other education centres safer, for instance, by increasing hygiene standards or purchasing new equipment to substitute the updated one. Therefore, all these investments aim to improve the quality of primary and secondary education.

2.2.10.3 Investments for vocational and tertiary education (Cluster 3)

Under this cluster, **operations mainly fund education infrastructure for vocational training and tertiary education and training programmes**. Some of them also attempt to improve the labour market relevance of education and training systems, facilitating the transition from education to work and strengthening vocational education and training systems and their quality, including mechanisms for skills anticipation and adaptation. The overall strategic objective of this cluster is to improve the quality of vocational and training education and its attractiveness.

2.2.10.4 Promotion of e-Leaning, e-Education and digital literacy (Cluster 4)

This is a very specific cluster of operations funded by three Italian programmes[34]. It is the only one under TO10 which has a horizontal focus on all types of education (i.e., primary, secondary, vocational and tertiary). Its peculiarity relies on the fact that **it aims to disseminate equipment, devices and digital services in the world of school and training** with the ultimate goal of promoting innovative educational approaches. Part of these operations was funded to respond to the need to organise e-Learning activities during the Covid-19 emergency.

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[34] The National Operational Programme on Education (2014IT05M2OP001), the regional OP Campania (2014IT16RFOP007) and the regional OP Basilicata (2014IT16RFOP0229).

2.2.11 Typologies of operations under the Thematic Objective 11 'Enhancing institutional capacity of public authorities and stakeholders and efficient public administration'

Operations under Thematic Objective 11 support investments to enhance the institutional capacity of public authorities and stakeholders. Their overall objective is to make public administration more efficient, especially in implementing ERDF and Cohesion Fund investments[35].

The clustering activity focused on 2,812 operations out of the total of 2,957 operations falling under TO11 (i.e., 95.1%), thus covering 92.1% of the total eligible expenditure allocated to the operations under this TO (whose total allocation in terms of total eligible expenditure is equal to EUR 1.6 billion).

As a result of the implementation of the k-means algorithm and the validation and revision of the clustering results, **a total of five different clusters were identified** based on the combination of IPs and FoIs, as shown in Figure 45: and summarised in the following table. See Annex I for more details on the average shares of all the IPs and FoIs characterising each cluster**Error! Reference source not found.Error! Reference source not found.**.

Table 11 –   List of clusters under TO11 and related predominant IPs and FoIs

Typology cluster	Top 1 IP	Top 3 FoIs
Cluster 1 - Enhancing efficiency in public administration for Transnational and Interregional Programmes	▪ **11c** (48%) ▪ Other non-predominant IPs (52%)	▪ **119** - Investment in institutional capacity: 100%
Cluster 2 - Enhancing efficiency in public administration for Operational Programmes	▪ **11a** (85%) ▪ Other non-predominant IPs (15%)	▪ **096** - Institutional capacity of public administrations (ERDF): 100%
Cluster 3 - Enhancing efficiency in public administration for Cross-border Programmes	▪ **11b** (100%)	▪ **119** - Investment in institutional capacity: 99.9% ▪ Other non-predominant FoIs: 0.1%
Cluster 4 - Promotion of public administration reforms through e-Government services and applications	▪ **11a** (100%)	▪ **078** - e-Government services & applications: 78.9% ▪ **087** - Adapt to climate change & prevent & manage climate risks: 10.9% ▪ **055** - Other social infrastructure: 5% ▪ Other non-predominant FoIs: 5.2%
Cluster 5 - Cooperation initiatives to enhance administrative capacities	▪ **11b** (100%)	▪ **120** - Capacity building for ESF stakeholders: 37% ▪ **112** - Enhancing access to services: 10.7% ▪ **096** - Institutional capacity of public administrations (ERDF): 9.2% ▪ Other non-predominant FoIs: 43.1%

Source: Authors

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[35] IP 11a for OPs, 11b for cross-border programmes, 11c for transnational programmes and 11d, 11e and 11f for interregional programmes.

Figure 45:   Combinations of IPs and FOIs by TO11 cluster
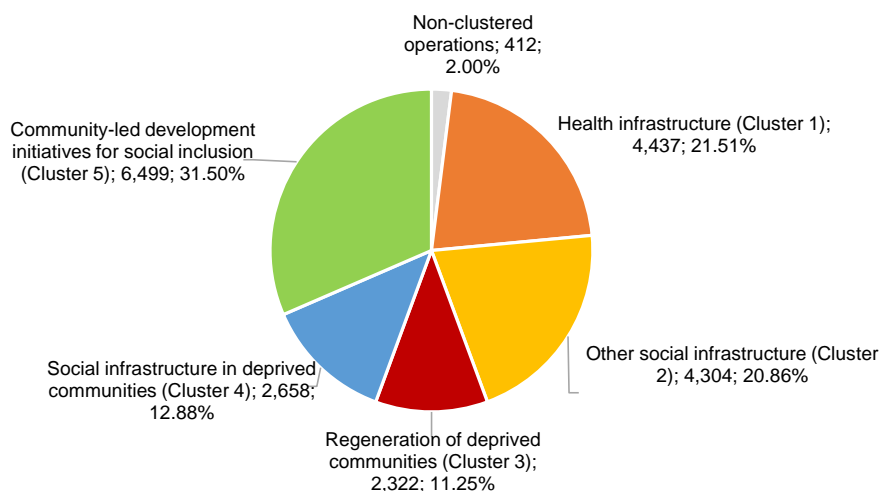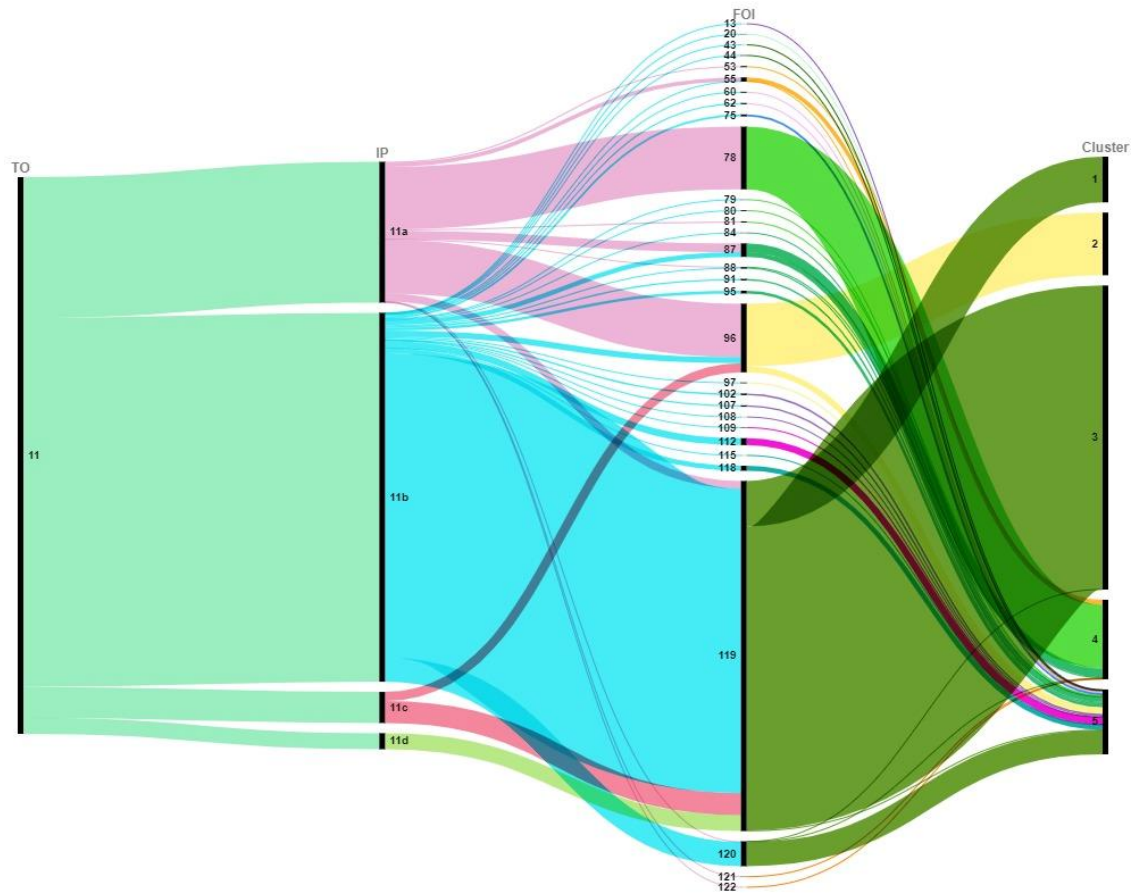

Source: Authors

Note: the alluvial diagram shows the number of clustered operations under TO11 and their distribution across the different IPs and FoIs. Operations with multiple IPs and/or FoIs are counted multiple times.

Operations aimed at enhancing efficient public administration in the context of cross-border programmes (Cluster 3) represent almost 52% of the total, while the rest of the operations are almost equally distributed across the remaining clusters.

Figure 46:   Number of operations by typology clusters in TO11
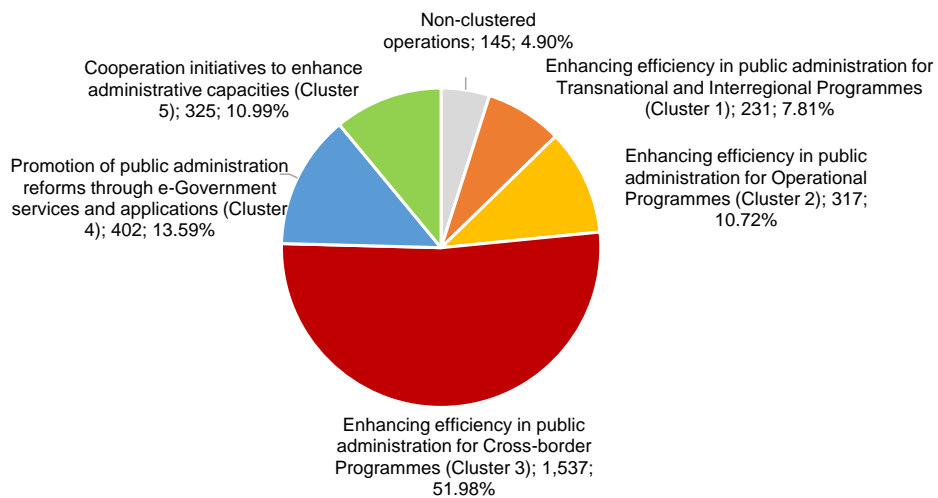
Source: Authors

When looking at the financial distribution of the total eligible expenditure allocated instead, the cluster absorbing the highest amount is funding operations aimed at enhancing efficient public administration for OPs (Cluster 2). This cluster is also the one funding operations with the largest average size.

Figure 47:   Percentage distribution of expenditure by typology clusters of TO11 (in billion EUR)
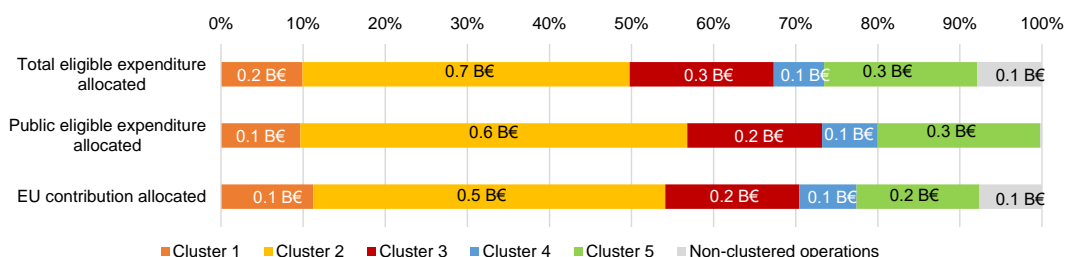
Legend: Cluster 1 - Enhancing efficiency in public administration for Transnational and Interregional Programmes, Cluster 2 - Enhancing efficiency in public administration for Operational Programmes, Cluster 3 - Enhancing efficiency in public administration for Cross-border Programmes, Cluster 4 - Promotion of public administration reforms through e-Government services and applications, Cluster 5 - Cooperation initiatives to enhance administrative capacities

Note: the total eligible expenditure allocated to clustered operations under TO11 amounts to EUR 1.6 billion, the eligible public expenditure to EUR 1.3 billion and the total EU allocation to EUR 1.2 billion. It should be noted that not for all operations financial data is available. The total eligible expenditure is available for all operations, while the eligible public expenditure is available for 2,496 operations out of 2,957 and the allocated EU contribution is available for 2,843 operations out of 2,957

Source: Authors

Figure 48:   Average total eligible, public eligible and EU allocated expenditure by cluster under TO11 (in thousand EUR)
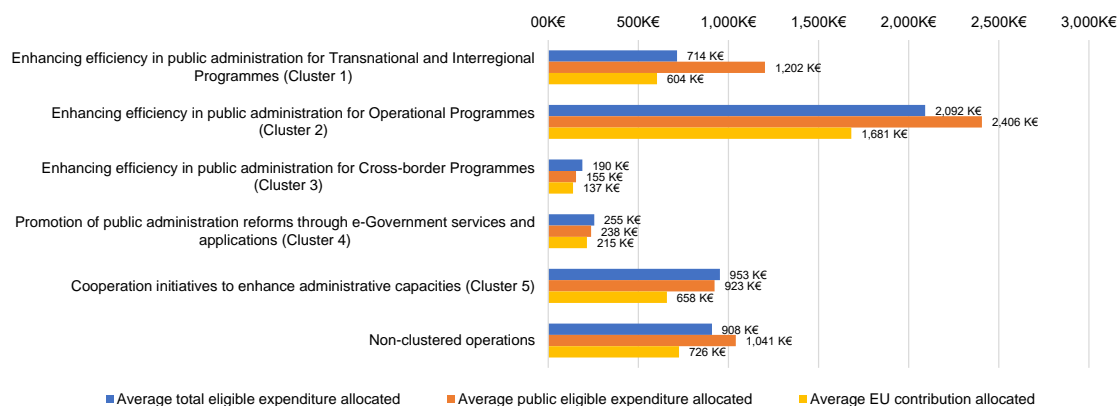
Source: Authors

In what follows, the main typology clusters emerging from the clustering exercise are presented. It should be noted that are some clusters funding very similar operations but in relation to different types of programmes (Cluster 1, 2 and 3).

2.2.11.1   Enhancing efficiency in public administration for Transnational and Interregional Programmes (Cluster 1)

Considering the strong relevance of IP 11c (Transnational Programmes) and 11d (Interregional Programmes), this cluster appears to focus **on providing investments in institutional capacity and the efficiency of public administration** concerning these

two types of programmes. In particular, the objective of these operations is to promote reforms, better regulation and good governance.

2.2.11.2   Enhancing efficiency in public administration for Operational Programmes (Cluster 2)

This cluster is similar to Cluster 1. The only difference is the focus on Operational Programmes rather than on Cooperation Programmes, as evinced by the IP 11a. Moreover, **they support institutional capacity initiatives aimed at making more effective and efficient the implementation of ERDF programmes**.

2.2.11.3   Enhancing efficiency in public administration for Crossborder Programmes (Cluster 3)

This cluster is very similar to Cluster 1. The only difference is still on the types of programmes it focuses on, namely Cross-border Programmes, as evinced by the IP 11b.

2.2.11.4   Promotion of public administration reforms through e-Government services and applications (Cluster 4)

This cluster funds operations aimed at promoting public administration reform through the **adoption of e-Government services and applications** and the management of climate change-related risks.

2.2.11.5   Cooperation initiatives to enhance administrative capacities (Cluster 5)

This is a cluster with a broad nature that is relevant only for Transnational Programmes. Under this cluster, there are operations funding capacity building activities and others aimed to enhance access to affordable, sustainable and high-quality services or improve the labour market relevance of education and training systems or even adapt to climate change and prevent its risks.

2.2.12 Typologies of operations under the Thematic Objective 12 'Technical assistance'

Operations under Thematic Objective 12 support activities of technical assistance provided to Managing Authorities. They aim to provide horizontal support to the governance of ERDF and Cohesion Fund programmes.

The clustering activity focused on 9,860 operations out of a total of 10,209 operations falling under TO12 (i.e., 96.5%), thus covering 97.3% of the total eligible expenditure allocated to the operations under this TO (whose total allocation in terms of total eligible expenditure is equal to EUR 10.4 billion[36]).

As a result of the implementation of the k-means algorithm and the validation and revision of the clustering results, **a total of five different clusters were identified** based on the combination of IPs and FoIs, as shown in Figure 49: and summarised in the following table. See Annex I for more details on the average shares of all the IPs and FoIs characterising each cluster**Error! Reference source not found.Error! Reference source not found.**.

Table 12 –   List of clusters under TO12 and related predominant IPs and FoIs

Typology cluster	Top 1 IP	Top 3 FoIs
Cluster 1 - Technical assistance for the preparation, implementation and monitoring of programmes	▪ **12a** (100%)	▪ **121** - Preparation, implementation, monitoring and inspection: 99.3% ▪ Other non-predominant FoIs: 0.7%
Cluster 2 - Technical assistance for the evaluation of programmes	▪ **12a** (100%)	▪ **122** - Evaluation and studies: 97.7% ▪ Other non-predominant FoIs: 2.3%
Cluster 3 - Technical assistance for the information and communication of programmes	▪ **12a** (100%)	▪ **123** - Information and communication: 99.7% ▪ Other non-predominant FoIs: 0.3%
Cluster 4 - Compensation of additional costs for outermost regions	▪ **12a** (100%)	▪ **099** – Outermost regions: compensation costs due to market size: 91.05% ▪ **098** - Outermost regions: compensation due to accessibility: 8.27% ▪ Other non-predominant FoIs: 0.68%

Source: Authors

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[36] Please note that the data on the total eligible expenditure is available for 10,192 operations out of 10,209.

**Figure 49:   Combinations of IPs and FOIs by TO12 cluster**
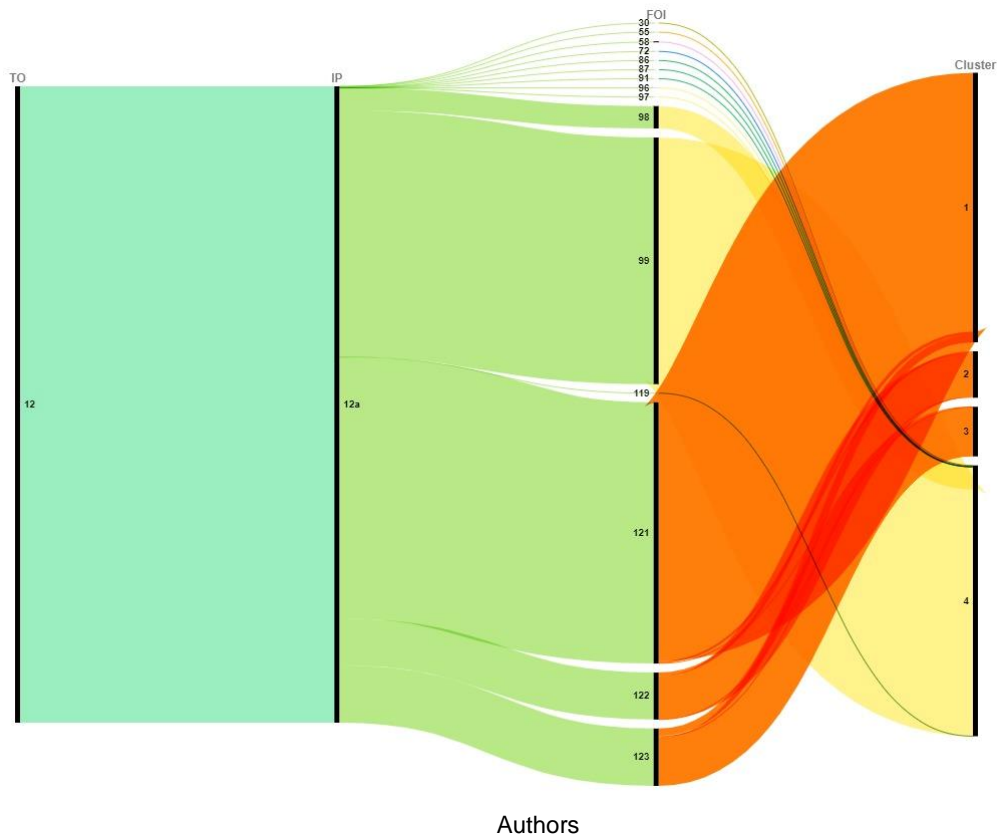
Source:
Authors

Note: the alluvial diagram shows the number of clustered operations under TO12 and their distribution across the different IPs and FoIs. FoIs. Operations with multiple IPs and/or FoIs are counted multiple times.

Most operations consist of technical assistance activities for the preparation, implementation and monitoring of programmes (Cluster 1) and compensation for the additional costs borne by Managing Authorities in outermost regions (Cluster 4).

Figure 50:   Number of operations by typology clusters in TO12
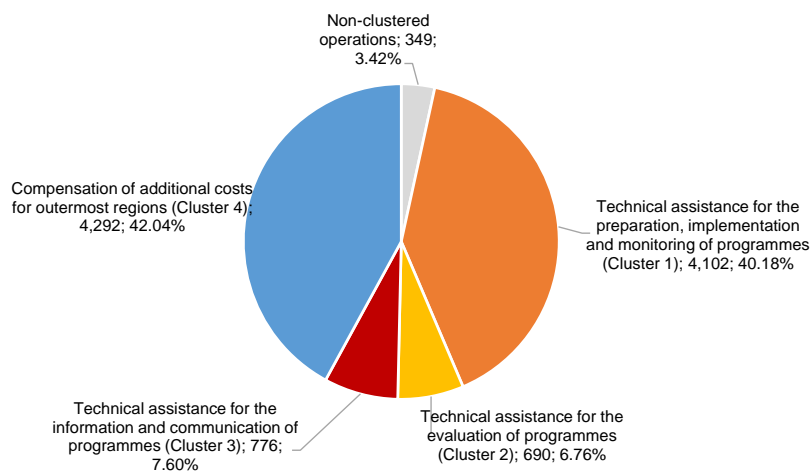
Source: Authors

Technical assistance activities for the preparation, implementation and monitoring of programmes (Cluster 1) also received the highest amount of total eligible expenditure allocated and has the higher average share of allocated expenditure. Only a residual

part is instead devoted to technical assistance activities funding evaluation studies (Cluster 2).

Figure 51:   **Percentage distribution of expenditure by typology clusters of TO12 (in billion EUR)**
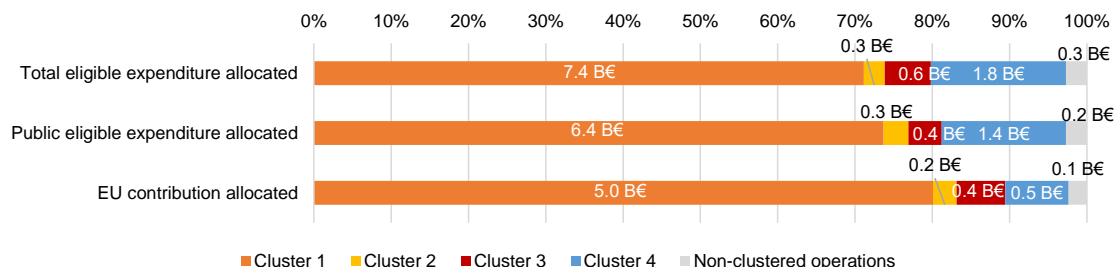
Legend: Cluster 1 - Technical assistance for the preparation, implementation and monitoring of programmes, Cluster 2 - Technical assistance for the evaluation of programmes, Cluster 3 - Technical assistance for the information and communication of programmes, Cluster 4 - Compensation of additional costs for outermost regions

Note: the total eligible expenditure allocated to clustered operations under TO12 amounts to EUR 10.4 billion, the eligible public expenditure to EUR 8.6 billion and the total EU allocation to EUR 6.2 billion. It should be noted that not for all operations financial data is available. The total eligible expenditure is available for 10,192 operations out of 10,209; the eligible public expenditure is available for 9,728 operations out of 10,209 and the allocated EU contribution is available for 8,824 operations out of 10,209

Source: Authors

Figure 52:   **Average total eligible, public eligible and EU allocated expenditure by cluster under TO12 (in thousand EUR)**
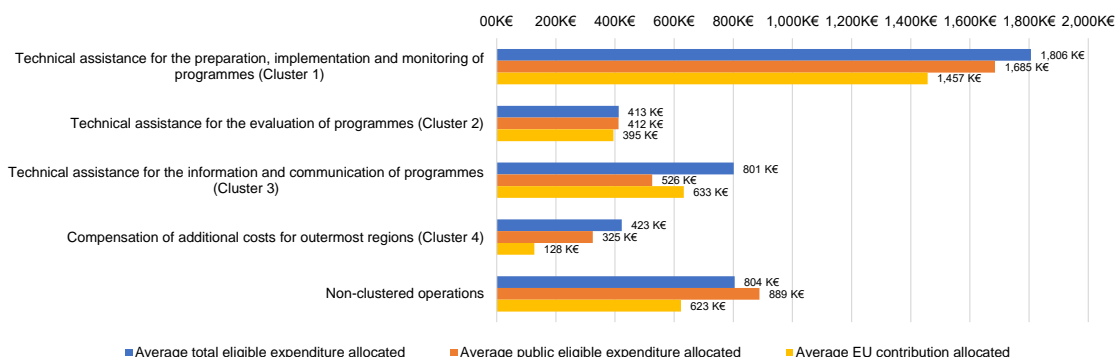
Source: Authors

In what follows, the main typology clusters identified are further described. It should be noted that this TO is not broken down into different Investment Priorities. This is why only the Fields of Intervention defines the different types of clusters that have emerged.

2.2.12.1   Technical assistance for the preparation, implementation and monitoring of programmes (Cluster 1)

These operations fund technical assistance activities to support Managing Authorities in preparing, implementing and monitoring Operational and Cooperation Programmes. Among the activities funded, there are, for instance, studies aimed at diagnosing the main issues and challenges of a territory, organising meetings and seminars for the management and monitoring of partnership agreements, or setting up monitoring systems.

2.2.12.2 Technical assistance for the evaluation of programmes (Cluster 2)

The operations funded under this cluster cover contracting external consultants to carry out evaluation studies on the funded OPs and CPs.

2.2.12.3 Technical assistance for the information and communication of programmes (Cluster 3)

This cluster funds operations aimed to promote the dissemination of information and communications related to OPs and CPs under implementation. For instance, there are operations developing actions in the media through the realisation of press conferences and public presentations of funded projects. They aim to increase public administration's accountability to beneficiaries and the overall public opinion.

2.2.12.4 Compensation of any additional costs for outermost regions (Cluster 4)

This cluster includes operations that compensate Managing Authorities located in outermost regions for additional costs because of accessibility deficit, territorial fragmentation, and size market factors. Compensation was offered, for instance, for the additional costs of the maritime and air transport of goods.

3. Clustering of beneficiaries

Data collected on beneficiaries in Deliverable D1 include several attributes, including local taxonomies, that can be used to classify beneficiaries along several dimensions:

- The **ownership structure**, i.e., whether the beneficiary is private or public;

- The **economic sector** in which the beneficiary is active;

- The **size** in terms of number of employees (mainly for enterprises[37]);

- The **type,** which identifies the main type of activity and the mission of the different beneficiaries.

While for the ownership, economic sector and size standard taxonomies are already adopted at the EU level (e.g., the NACE rev.2 classification for the economic sector), there is no standard classification of the types of beneficiaries. In this respect, it should be noted that two European Commission studies have attempted a classification of the types of beneficiaries: the 2007-2013 RTD ex-post evaluation and the European Parliament and Centre for European Policy Studies (CEPS) study on "The Largest 50 beneficiaries in each EU Member State of CAP and Cohesion Funds"[38]. However, the former classified only institutions generally involved in R&D activities (and it may therefore be partial) and the latter distinguished beneficiaries in terms of types of natural and legal personalities. Instead, in the context of this study, **the ambition was to cluster beneficiaries according to their core mission and nature** more than their legal status or economic classifications. Nevertheless, such studies were considered as an inspiration for defining this new taxonomy. The taxonomy was also developed in light of the potential use of the proposed classification in the context of future thematic evaluations.

Although Managing Authorities provided a local classification of beneficiaries for almost 60% of the total number, great differences in the taxonomies used between and within the Member States were noted. In total, more than 1,600 labels were available, and the preliminary analysis of sub-samples of beneficiaries under these labels showed that it was not possible to reconcile the different taxonomies, except for very specific cases. As a result, the attribution of the type of beneficiary was made mainly by:

1. **Looking for keywords or groups of keywords in the beneficiary's name** provided by the MA or translated by the Core Team into English;

2. **Analysing the co-occurrence of keywords** associated with different typologies to identify the one that better defined such beneficiaries[39] (see some examples in the Figure below).

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[37] Both in the Orbis database and in the data provided by the Managing Authorities, the size may be available not only for enterprises, but also for other institutions.

[38] https://www.europarl.europa.eu/thinktank/en/document.html?reference=IPOL_STU(2021)679107

[39] As an example, the beneficiary 'Oulu University of Applied Sciences Oy' includes two keywords associated with two different types of beneficiaries, namely 'oy' associated with 'enterprise' and 'university' associated with 'Higher Education Institution'. In such a case, the dominant keyword was "university", and the beneficiary was therefore classified as a 'Higher Education Institution'.

Figure 53:   Some keywords in the beneficiary's name used to attribute some of the type dimension identified
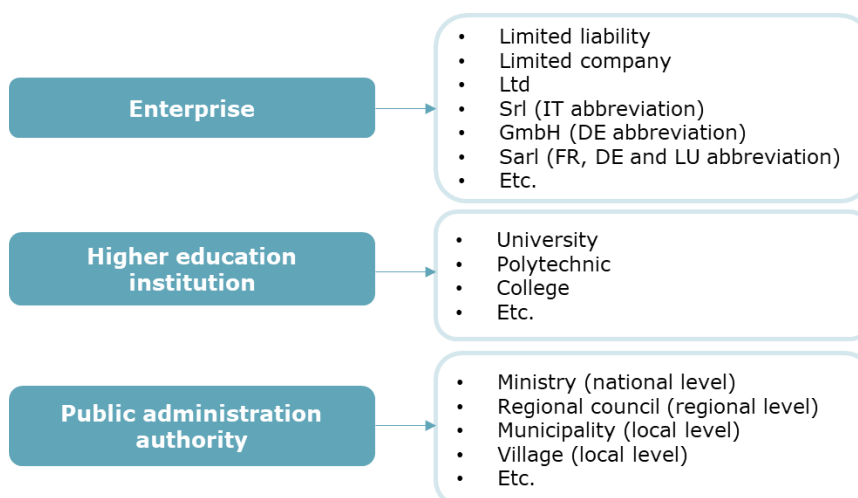
Source: Authors

Then, local taxonomies available in the raw data provided by the Managing Authorities and information on the NACE code associated with beneficiaries (provided by the MA or retrieved from the ORBIS database) were used to fill the gaps. More specifically, local taxonomies and NACE codes were used only whenever it was possible to reconcile the local label with the standard taxonomy defined by the team. This reconciliation was made through the manual revision and analysis of beneficiaries, for which it was not possible to attribute the type using keywords (see above).

As the last step, the attribution of the type classification was randomly checked on a sample of beneficiaries, cross-checking it with other classification dimensions, such as the beneficiary ownership and size. Manual refinements were also performed with the support of Country Experts[40].

It should be noted that **the proposed strategy for attributing the beneficiary type presents some limitations**, namely:

1. Classifying beneficiaries according to their mission in a semi-automated way and without an in-depth analysis of their activity and nature may be difficult and prone to some arbitrary interpretations;

2. Not all beneficiary's names include keywords that can be associated with a specific typology, and they may also not have an associated local taxonomy provided by the MA; this means that not all beneficiaries could be classified under a standard taxonomy;

3. Considering that final refinements were manually performed only on a sample of beneficiaries, it cannot be ensured that all beneficiaries fall under the most appropriate typology; however, with the support of the Country Experts, it has been possible to validate the attribution for most beneficiaries located in the largest countries.

Notwithstanding the mentioned limitations, the proposed approach was considered the best solution considering that it combined an automated and manual analysis of beneficiaries. It should also be noted that an additional variable identifying those beneficiaries that are limited liability companies by legal status has been included in the

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[40] The Country Experts of Czech Republic, Germany, Spain, Greece, France, Italy, Romania, Portugal and Poland were involved in this exercise. On average, they contributed to classify almost 55% of the "unclassified" beneficiaries.

single database. In this way, it is possible to identify enterprises that may have been classified under another typology because of their core mission (e.g. cluster or technology transfer organisations, etc.)

As a result of the clustering exercise, a total of 12 macro-categories of beneficiaries have been identified, of which four can be further split into 16 sub-categories in some cases. They are described below:

Table 13 – The taxonomy of the types of beneficiaries

Beneficiary type	Description
Enterprises - label "*Enterprise*"	Enterprises cover limited public (e.g. state-owned) or private companies and limited partnerships and cooperatives whose legal status is that of a limited liability company. This means that this category comprises those beneficiaries who produce and sell products or services for profit (commercial purposes) or not. However, this category does not include all organisations having the legal status of limited liability company; those enterprises with the following mission are excluded: • Those providing services of public interest, such as hospitals, clinic or treatment centres, private schools and other training organisations, enterprises being infrastructure and service providers; • Those providing technology transfer services to other organisations, such as cluster organisations, science and technology parks, competence centres, etc. • Those providing financial services, such as banks and other financial institutions.
Natural persons - label "*Natural person*"	This category includes both natural persons carrying out business activity and those not carrying out any business activity. The distinction between the two cases is generally not possible unless the Managing Authority provided additional specific information. In these cases, the label includes the following specification: • The label "*Natural person - business*", for natural persons carrying out a business activity; • The label "*Natural person – no business*", for natural persons that do not carry out a business activity. It should be noted that the name of beneficiaries classified as natural persons not involved in business activities were **anonymised to ensure compliance with the GDPR.** In particular, the variable variable "beneficiary's name" in the dataset of beneficiaries has been anonymised when: • Explicitly requested by the Managing Authority; • It was possible to identify that the beneficiary was a natural person, not involved in business activities, based on the classification provided by the Managing Authority (see Section 3).
Research and technology transfer organisations - label "*Research and technology transfer organisation*"	Institution/organisations whose primary mission is to conduct research and development activities and projects and support businesses in conducting research activities. Considering this two-fold objective, whenever possible, the team has distinguished between: • **Research organisations** (label "*Research organisation*"): These are the organisations whose primary mission is to conduct research and development activities, such as national research centres; • **Science and Technology Parks** (label "*S&T Park*"): These are areas/buildings hosting companies and knowledge-based institutions (e.g. universities, research centres, etc.) involved in technologically-intensive and innovative activities. The S&T park provides services for technology transfer, collaboration, incubation, and other value-added services, together with spaces and facilities. • **Technology transfer organisations** (label "*Technology transfer organisation*"): These are organisations whose primary mission is to facilitate the process of transferring (disseminating) technology between different organisations, such as between universities and enterprises or between large and small enterprises, etc. • **Incubator centres** (label "*Incubator*"): These organisations help startup companies and individual entrepreneurs develop their business idea by providing a full-scale range of services, from management training and office space to venture capital financing.

Beneficiary type	Description
	• **Competence centres** (label "*Competence centre*"): These are forms of university-industry research alliance combining academic excellence with industrial needs. Instead, the category excludes organisations having complementary activities to research, such as Universities.
Higher education institutions - label "*Higher education institution*"	Organisations conducting tertiary education as their main mission, but which could also conduct research and development activities. It includes Universities, Technical Universities, Grandes Ecoles, etc., and research centres within universities.
Other education and training institutions - label "*Other education institution*"	Organisations conducting pre-primary, primary and secondary education and training activities as their main mission. They include, for instance, kindergarten, elementary schools, middle schools, high schools and training centres.
Public administration authorities - label "*Public administration*"	Public administration authorities are those institutions implementing the government policies and operating at different administrative levels, namely national, regional or local. Whenever possible, the team have distinguished between: • **Public administration authorities at the national level** (label "Public administration | National level"), such as ministries or state departments; • **Public administration authorities at the regional level** (label "Public administration | Regional level"), such as regional council; • **Public administration authorities at the local level** (label "Public administration | Local level"), such as municipalities or associations or municipalities.
Public agencies - label "*Public agency*"	Public agencies are semi-permanent or permanent bodies created by public administration authorities and supervised by the latter. They are generally responsible for the oversight and administration of specific functions of the public administration authority by which they have been created. For instance, they include national or regional development agencies, space agencies, environment agencies, energy agencies, health agencies, statistical offices, etc.
Other institution of public interest - label "*Other institution of public interest*"	These are institutions, generally but not necessarily with public ownership, which provides services or have a mission of general public interest, such as: • **The promotion of cultural heritage, tourism, sport or the protection of the environment**. Examples of institutions can be tourism or sports associations, museums or other institutions promoting cultural heritage. Whenever it was possible to identify them clearly, beneficiaries have been labelled as "*Other institution of public interest | Culture, tourism, sport, environment*"; • **Healthcare services and health prevention**. These services are provided by public or private hospitals, clinics and treatment centres. They also include university hospitals and medical schools. Whenever it was possible to identify them clearly, beneficiaries have been labelled as "*Other institution of public interest | Healthcare*"; • **Transport services, waster and water management services, electricity and gas services**. Private or public enterprises may provide these services with national, regional or local support. This category includes the following organisations/institutions: providers of metropolitan or railway services, airports, providers of waste and water management services. Whenever it was possible to clearly identify them, beneficiaries have been labelled as "*Other institution of public interest | Providers of public services*"; • **Other social services** catered to families, children, youths, elders, women, the sick and the disabled, such as hospices, housing associations, institutions providing services to the sick and the disabled, etc. Whenever it was possible to clearly identify them, beneficiaries have been labelled as "*Other institution of public interest | Social services*"; • **Public security services**. They are mainly provided by the police and fire brigades. Whenever possible, such beneficiaries have been labelled as "*Other institution of public interest | Public security*".

Beneficiary type	Description
	There may also be other public interest organisations not specifically pursuing activities entering one of the fields mentioned above. In those cases, only the general classification of "*Other public interest institution*" has been provided.
Chamber of commerce and business association (label "C*hamber of commerce and business association*")	This is a form of business organisation/association/network whose goal is to promote and represent the interests of businesses.
Business support organisation (label "Business support organisation")	This category includes organisations providing generic support services to businesses. They may include:. • **Cluster organisation** (label "*Cluster organisation*"): This is a body supporting the collaboration and networking of a group of firms and/or research and technology organisation and other related economic actors and institutions, that are located near each other. They generally act as business support and innovation service providers. • **Other organisation** (label "*Other*"): This is an organisation different from cluster organisation and research and technology transfer organisation providing other support services to businesses.
Financial institutions - label "*Financial institution*"	These institutions may include enterprises providing financial institutions, such as banks, European institutions such as the European Investment Bank (EIB) or the European Investment Fund (EIF), as well as national or regional funds created to provide funds and financial services to enterprises, households or other actors.
Trade unions - label "*Trade union*"	Trade unions are organisations of workers whose aim is to achieve common goals, such as protecting the integrity of their trade, improving safety standards, and attaining better wages and benefits.
NGOs and civil society associations - label "*NGO and civil society association*"	Other associations, generally not-for-profit, providing services to civil society in general. They may include charities, no-profit foundations, volunteering and humanitarian association, churches and other religious associations.

All those beneficiaries for which the attribution strategy did not or could not provide results (e.g., anonymised beneficiaries) were labelled as "Unclassifiable". Overall, 1,080,047 beneficiaries fell under one of the identified typology clusters (92.4% of the total[41]), while 88,394 were not classified. Specifically, 13,257 could not be classified because of the anonymisation of the name ("Unclassifiable"), and 75,137 were not classified using the proposed attribution strategy.

As shown in the Figure below, most direct beneficiaries and final recipients were classified as enterprises, followed by public administrations and natural persons.

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[41] Considering only the total number of beneficiaries for which data is available.

Figure 54:   Distribution of all beneficiaries across the different macro-types
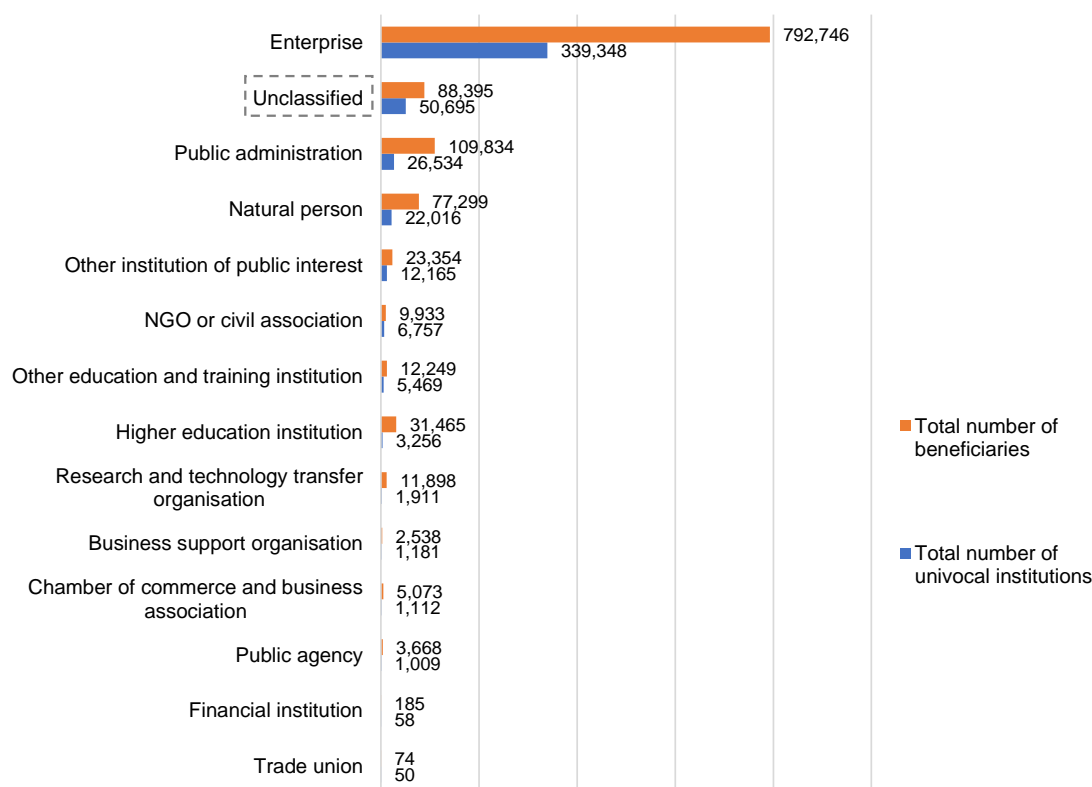
Note: when counting univocal institutions, a total of 346,464 beneficiaries for which data has been anonymised were deleted.

Source: Authors

When focusing only on those beneficiaries having the role of direct beneficiaries or final recipients (thus excluding 8,841 beneficiaries with roles specific of Interreg programmes, cf. Section 3.2.1 of the Deliverable D2), 92.5% of the total number of direct beneficiaries and final recipients could be classified (i.e., 1,073,894 out of 1,159,870). As shown in the Figure below, most direct beneficiaries and final recipients were classified as enterprises, followed by public administrations and natural persons. Only 73 of them are trade unions and 183 financial institutions. A slightly different picture emerges when excluding duplicates and focusing only on univocal institutions. Enterprises remain the main types of beneficiaries, followed by public administrations. However, NGOs and other institutions of public interest are more numerous than natural persons.

Figure 55: **Distribution of direct beneficiaries and final recipients across the different macro-types**
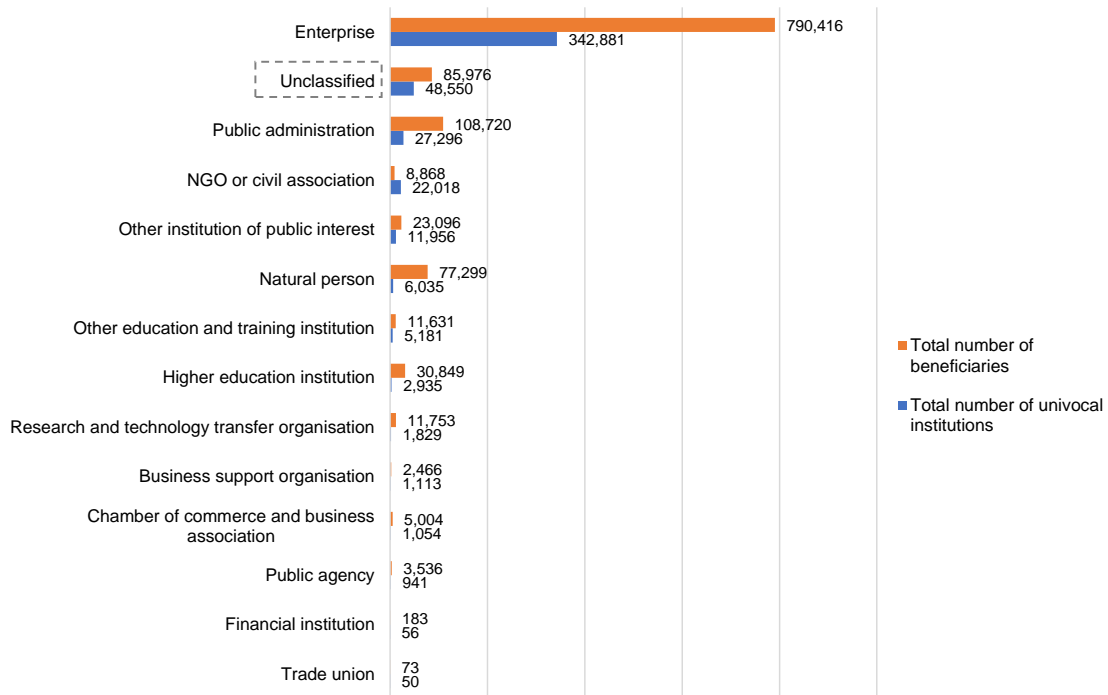
Note: when counting univocal institutions, a total of 346,418 beneficiaries for which data has been anonymised were deleted.

Source: Authors

By analysing the distribution of the different types of direct beneficiaries and final recipients across Thematic Objectives, it emerges that most enterprises and natural persons are beneficiaries of operations under the Thematic Objective 02. Higher education institutions and research and technology transfer organisations are instead mainly beneficiaries of operations under the Thematic Objective 01.

Figure 56: **Percentage distribution of different types of direct beneficiaries and final recipients across Thematic Objectives**
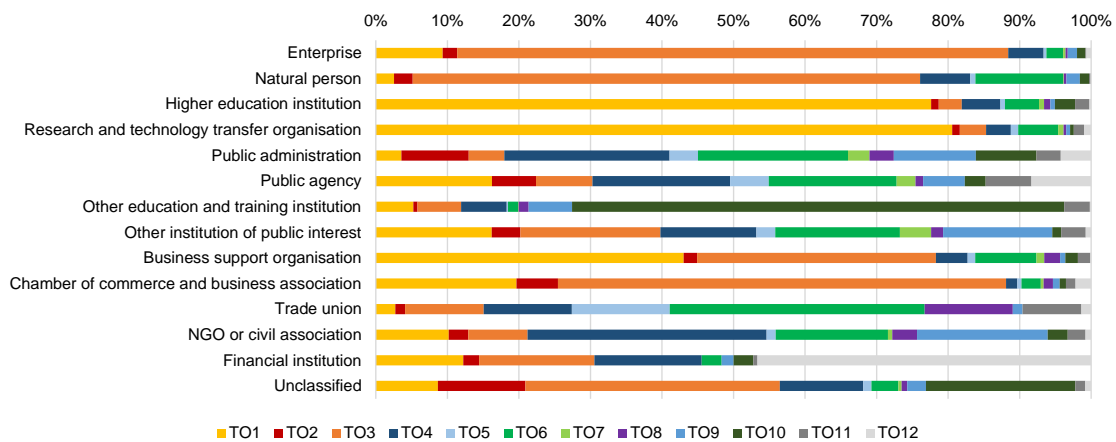
Note: this figure excludes beneficiaries of operations falling under multiple TOs or for which the information on the TO is missing. The total number of beneficiaries considered is 1,143,344

Source: Authors

Focusing only on direct beneficiaries, it is also possible to estimate the amount of total and public expenditure as well as EU contribution allocated to the direct beneficiaries of selected operations. However, the limited availability of financial data at the beneficiary level should be noted [42]. Overall, the figure below shows that public administration authorities and enterprises receive the highest amount of total and public eligible expenditure and allocated EU contribution. However, public administration authorities for which data is available are only between 29 and 35% of the total number of public administration authorities, as well as enterprises for data is available are only around 20% of the total number of enterprises.

Figure 57: Amount of expenditure by type of direct beneficiaries (million EUR)

Total eligible expenditure allocated (N=191,526; 27%)

Type	Amount
Public administration (N=34,947; 34%)	58,020.6M€
Enterprise (N=87,206; 21%)	53,937.2M€
Other institution of public interest (N=8,282; 38%)	27,560.3M€
Unclassified (N=9,606; 14%)	6,065.2M€
Higher education institution (N=10,495; 34%)	6,012.3M€
Research and technology transfer organisation (N=3,571; 31%)	3,440.2M€
Natural person (N=29,024; 65%)	2,341.8M€
NGO or civil association (N=3,215; 36%)	2,258.2M€
Public agency (N=1,452; 41%)	1,471.3M€
Financial institution (N=62; 34%)	1,377.7M€
Other education and training institution (N=1,097; 10%)	549.0M€
Business support organisation (N=1,387; 57%)	356.2M€
Chamber of commerce and business association (N=1,147; 23%)	328.1M€
Trade union (N=35; 48%)	06.6M€

Public eligible expenditure allocated (N=172,420; 24%)

Type	Amount
Public administration (N=30,430; 29%)	50,181.9M€
Enterprise (N=83,241; 20%)	36,127.3M€
Other institution of public interest (N=6,800; 31%)	25,385.0M€
Higher education institution (N=7,696; 25%)	4,790.3M€
Unclassified (N=6,227; 8%)	4,121.1M€
Research and technology transfer organisation (N=2,795; 24%)	2,913.3M€
NGO or civil association (N=2,812; 32%)	1,900.2M€
Natural person (N=29,018; 65%)	1,616.8M€
Financial institution (N=52; 28%)	1,369.2M€
Public agency (N=786; 22%)	1,201.4M€
Other education and training institution (N=815; 71%)	434.1M€
Chamber of commerce and business association (N=845; 17%)	232.4M€
Business support organisation (N=875; 36%)	213.8M€
Trade union (N=28; 38%)	03.5M€

EU contribution allocated (N=188,927; 26%)

Type	Amount
Public administration (N=35,699; 35%)	44,304.8M€
Enterprise (N=84,805; 20%)	31,295.9M€
Other institution of public interest (N=8,092; 37%)	22,129.6M€
Unclassified (N=9,440; 13%)	4,088.4M€
Higher education institution (N=10,147; 33%)	4,014.3M€
Research and technology transfer organisation (N=3,476; 30%)	2,403.1M€
NGO or civil association (N=3,223; 36%)	1,665.8M€
Natural person (N=29,014; 65%)	1,511.6M€
Public agency (N=1,441; 41%)	1,113.6M€
Financial institution (N=61; 34%)	1,070.4M€
Other education and training institution (N=1,087; 9%)	351.6M€
Business support organisation (N=1,341; 55%)	230.3M€
Chamber of commerce and business association (N=1,066; 21%)	178.0M€
Trade union (N=35; 48%)	04.1M€

Note: the number of direct beneficiaries varies depending on the type, because not for all beneficiaries financial data on the total, public and EU allocated contribution was available.

Source: Authors

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[42] Final recipients cannot be included in these statistics, as different financial data are available for final recipients and direct beneficiaries.

When analysing more in-depth the nature of specific typologies of direct beneficiaries and final recipients, what emerges is that:

- There are a total of more than 77,000 natural persons, but for 39.4%, it is not possible to say whether they are engaged in business activities (see Figure 58:);

- Research organisations represent the main sub-type of beneficiary under Research and Technology Transfer organisations, while technology transfer organisation represents only 8% of these beneficiaries (see 0);

- Public administration authorities operate mostly at the local level (see Figure 60:);

- Public interest institutions are very varied (see Figure 61:);

- Almost half of the identified business support organisations are cluster organisations (see Figure 62:).

Figure 58:   Distribution of natural persons by sub-type
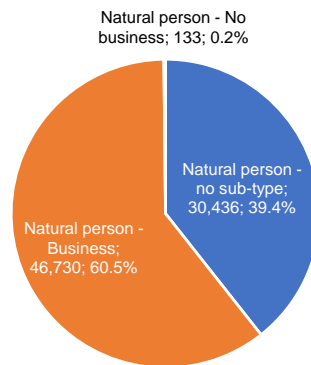
Note: all beneficiaries having the macro-role of direct beneficiaries or final recipients included in the database are counted. This means that institutions benefitting from more than one operation are counted multiple times.

Source: Authors

Figure 59:   Distribution of research and technology transfer organisation by sub-type
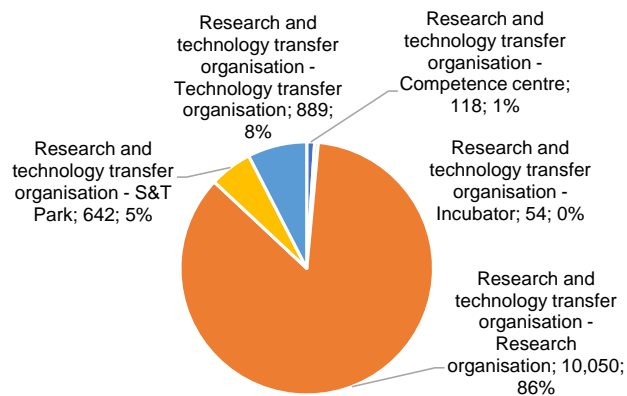
Note: all beneficiaries having the macro-role of direct beneficiaries or final recipients included in the database are counted. This means that institutions benefitting from more than one operation are counted multiple times.

Source: Authors

Figure 60: **Distribution of public administration institution by sub-type**
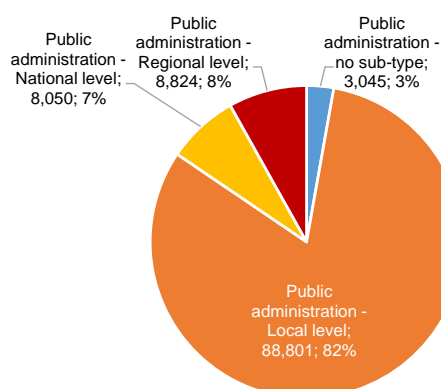
Note: all beneficiaries having the macro-role of direct beneficiaries or final recipients included in the database are counted. This means that institutions benefitting from more than one operation are counted multiple times.

Source: Authors

Figure 61: **Distribution of other public interest institutions by sub-type**
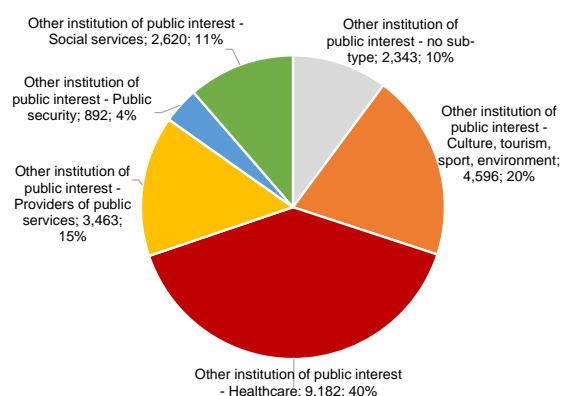
Note: all beneficiaries having the macro-role of direct beneficiaries or final recipients included in the database are counted. This means that institutions benefitting from more than one operation are counted multiple times.

Source: Authors

Figure 62: **Distribution of business support organisation by sub-type**

Note: all beneficiaries having the macro-role of direct beneficiaries or final recipients included in the database are counted. This means that institutions benefitting from more than one operation are counted multiple times.

Source: Authors

4. Further potential developments of the clustering

This clustering exercise on operations and beneficiaries can be further refined and revised in the context of future ex-post thematic evaluations depending on the type of analysis that will have to be carried out. Regarding the **clustering of operations**, the typology developed and attributed by the team may be revised in the following ways:

- **Manual refinements of the typology clusters**: As shown in Section 2.2, the nature of the typology clusters identified by the k-means algorithm is varied. Some are very focused and specific while others have a hybrid nature and include very different operations types. The team already made some manual refinements, but the typology cluster assigned to each operation may also be further revised in the context of thematic ex-post evaluations. Future evaluators may propose adjustments, creating new typologies by splitting an existing cluster or re-classifying operations under a different, better fitting cluster.

- **Manual attribution of identified typology clusters to non-clustered operations:** As shown in Section 2.1, not all operations included in the single database could be clustered. In some cases, the information on the IP or the FoI and/or their shares was missing. An additional attempt to fill data gaps in the IP variable could be made after further enrichment of the variable 'Specific Objective', as described in Chapter 4 of Deliverable D2. Then, a manual attribution of the typology cluster may be attempted based on the IP(s) or the FoI(s) characterising non-clustered operations for those for which such information is available.

Regarding the **classification of beneficiaries**, the following activities may be carried out:

- **Further manual revision of the attribution of the type of beneficiary**: Future evaluators may perform a more systematic check of the attribution of the type classification.

- **Manual attribution of the ownership and type dimension to unclassified beneficiaries**: As shown in Section 3, not all beneficiaries could be classified along with the ownership, size and type dimension. However, for the ownership and the type dimension, additional attributions may be made based on a web search of beneficiaries.

ANNEXES

Annex I. Distribution of IPs and FoIs across clusters

Figure 63: Distribution of IPs and FoIs across the clusters of TO1

Cluster 1		Cluster 2		Cluster 3		Cluster 4		Cluster 5		Cluster 6	
R&I infrastructure and capacities in research centres		R&I processes in SMEs		R&I infrastructure, capacities and equipment in SMEs		Business investments in R&I		R&I activities in research centres		Technology transfer	

IP code	Average share	IP code	Average share	IP code	Average share	IP code	Average share	IP code	Average share	IP code	Average share
1a	100%	1b	100%	1b	100%	1b	100%	1b	100%	1b	100%

FOI code	Average share	FOI code	Average share	FOI code	Average share	FOI code	Average share	FOI code	Average share	FOI code	Average share
058	28.553%	064	99.837%	056	93.926%	002	21.144%	060	99.865%	062	99.924%
060	28.053%	002	0.134%	064	5.374%	061	19.491%	062	0.047%	069	0.016%
064	26.197%	001	0.006%	065	0.296%	066	15.695%	059	0.030%	067	0.015%
061	4.975%	082	0.005%	001	0.258%	063	14.529%	061	0.022%	058	0.012%
065	3.749%	060	0.004%	057	0.029%	067	5.917%	065	0.012%	075	0.009%
062	3.676%	062	0.004%	069	0.029%	065	5.321%	071	0.007%	071	0.004%
059	1.122%	056	0.003%	004	0.019%	057	4.947%	002	0.007%	092	0.004%
056	0.968%	067	0.003%	067	0.019%	058	2.604%	064	0.003%	064	0.004%
063	0.803%	081	0.002%	066	0.017%	053	1.418%	087	0.003%	066	0.004%
050	0.236%	066	0.001%	058	0.010%	001	1.392%	063	0.002%	061	0.003%
066	0.176%	069	0.001%	059	0.010%	082	1.233%	013	0.001%	082	0.003%
067	0.173%			062	0.010%	059	0.977%			063	0.002%
057	0.141%			071	0.004%	050	0.826%				
075	0.134%					097	0.621%				
049	0.105%					096	0.558%				
002	0.100%					069	0.516%				
069	0.095%					077	0.510%				
081	0.087%					060	0.283%				
077	0.086%					101	0.279%				
096	0.080%					075	0.261%				
082	0.078%					081	0.228%				
121	0.073%					064	0.180%				
079	0.066%					068	0.160%				
001	0.047%					112	0.160%				
013	0.043%					056	0.136%				
092	0.034%					079	0.076%				
119	0.027%					073	0.074%				
087	0.019%					071	0.063%				
014	0.019%					119	0.057%				
011	0.017%					055	0.040%				
071	0.016%					062	0.035%				
003	0.013%					087	0.034%				
080	0.008%					004	0.031%				
019	0.007%					044	0.023%				
078	0.007%					070	0.023%				
106	0.007%					118	0.023%				
118	0.007%					094	0.017%				
120	0.007%					013	0.011%				
						043	0.011%				
						078	0.011%				
						088	0.011%				
						092	0.011%				
						012	0.006%				
						018	0.006%				
						047	0.006%				
						072	0.006%				
						076	0.006%				
						080	0.006%				
						083	0.006%				
						084	0.006%				
						085	0.006%				
						089	0.006%				
						049	0.003%				

Legend IPs:

1a - R&I infrastructure and capacities   1b - Business investment in R&I

Legend FoIs:

001 - Generic productive investment in SMEs
002 - Research and innovation processes in large enterprises
003 - Productive invest. in large enterprises linked to LCE
004 - Coop. between large & SMEs in ICT products & services
011 - Renewable energy: biomass
012 - Other renewable energy (hydro, geo, etc) & RE integration
013 - Energy efficiency renovation of public infra. & demo.
014 - Energy efficiency renovation of housing stock & demo
018 - Household waste mgmt (incl. Mech, Bio, thermal & landfill)
019 - Commercial, industrial or hazardous waste management
043 - Clean urban transport infrastructure & promotion

053 - Health infrastructure
055 - Other social infrastructure
056 - Investment in SMEs directly linked to R&I activities
057 - Invest. in large companies linked to R&I activities
058 - Research and innovation infrastructure (public)
059 - R+I infrastructure (private, incl. science parks)
060 - R+I activities in public research centres
061 - R+I activities in private research centres incl. Networks
062 - Tech-transfer & university-SME cooperation
063 - Cluster support & business networks (SMEs)
064 - R+I processes in SMEs (vouchers, process, design .)

069 - Support to enviro-friendly production processes in SMEs
070 - Promotion of energy efficiency in large enterprises
071 - Firms specialised in LCE & climate service
072 - Business infra. for SMEs (incl. industrial parks & sites)
073 - Support to social enterprises (SMEs)
075 - Development / promotion of tourism services in/for SMEs
076 - Dev. & promotion of cultural & creative assets in SMEs
077 - Dev. & promotion of cultural & creative services in SMEs
078 - e-Government services & applications
079 - Access to public sector info. (incl. E-tourism, e-culture)
080 - e-Inclusion, e-Accessibility, e-Learning & e-Education

085 - Biodiversity, nature protection & green infrastructure
087 - Adapt to climate change & prevent & manage climate risks
088 - Prevent & manage non-climate related natural risks
089 - Rehabilitation of industrial sites and contaminated land
092 - Protect, develop & promote public tourism assets
094 - Protect, develop & promote public cultural assets
096 - Institutional capacity of public administrations (ERDF)
097 - Community-led local development strategies (ERDF)
101 - Cross-financing under ERDF (support to ESF-type actions)
106 - Adapting of workers, enterprises & entrepreneurs to change
112 - Enhancing access to services

044 - Intelligent transport systems

047 - ICT: V-high-speed broadband (access/local loop; >100 Mbps)

049 - Education infrastructure for tertiary education

050 - Education infrastructure for VET & adult learning

065 - R+I processes, tech-transfer & cooperation in firms on LCE

066 - Advanced support services for SMEs

067 - SME business development, entrepreneurship & incubation

068 - Energy efficiency & demo. projects in SMEs

081 - ICT solutions addressing healthy, active ageing & e-Health

082 - ICT Services & applications for SMEs

083 - Air quality measures

084 - Integrated pollution prevention and control (IPPC)

118 - Strengthening vocational education & training

119 - Investment in institutional capacity

120 - Capacity building for ESF stakeholders

121 - Preparation, implementation, monitoring and inspection

Source: Authors

Figure 64: Distribution of IPs and FoIs across the clusters of TO2

Cluster 1	Cluster 2	Cluster 3
ICT infrastructures: backbone / backhaul network and broadband	ICT products and services, especially for enterprises, including e-commerce	ICT services and infrastructures in the public sector

IP code	Average share
2a	100%

IP code	Average share
2b	92%
2a	8%

IP code	Average share
2c	99.7%
2a	0.3%

FOI code	Average share
046	90.55%
047	8.69%
045	0.67%
048	0.08%

FOI code	Average share
082	95.76%
066	1.12%
046	1.09%
080	0.72%
004	0.57%
048	0.46%
078	0.20%
081	0.06%
079	0.02%
095	0.01%

FOI code	Average share
078	57.04%
080	15.04%
079	12.31%
081	8.91%
046	2.11%
048	1.75%
082	0.84%
047	0.59%
096	0.53%
065	0.18%
044	0.15%
049	0.09%
066	0.07%
045	0.06%
053	0.06%
111	0.06%
101	0.04%
114	0.04%
121	0.02%
001	0.02%
017	0.02%
064	0.02%
085	0.02%
095	0.02%
097	0.02%
112	0.02%

Legend IPs:

2a - Broadband deployment and high-speed networks

2b - ICT products and services, e-commerce

2c - E-government, e- learning, e-inclusion, e-culture and e-health

Legend FoIs:

001 - Generic productive investment in SMEs

004 - Coop. between large & SMEs in ICT products & services

017 - Household waste mgmt. (incl. minimise, sort, recycle)

044 - Intelligent transport systems

045 - ICT: Backbone/backhaul network

046 - ICT: High-speed broadband (access/local loop; >/= 30 Mbps)

047 - ICT: V-high-speed broadband (access/local loop; >100 Mbps)

053 - Health infrastructure

064 - R+I processes in SMEs (vouchers, process, design)

065 - R+I processes, tech-transfer & cooperation in firms on LCE

066 - Advanced support services for SMEs

078 - e-Government services & applications

079 - Access to public sector info. (incl. E-tourism, e-culture)

080 - e-Inclusion, e-Accessibility, e-Learning & e-Education

085 - Biodiversity, nature protection & green infrastructure

095 - Develop & promote public cultural & heritage services

096 - Institutional capacity of public administrations (ERDF)

097 - Community-led local development strategies (ERDF)

101 - Cross-financing under ERDF (support to ESF-type actions)

111 - Combating all forms of discrimination

112 - Enhancing access to services

048 - ICT: Other types of ICT infrastructure

049 - Education infrastructure for tertiary education

081 - ICT solutions addressing healthy, active ageing & e-Health

082 - ICT Services & applications for SMEs

114 - Community-led local development strategies

121 - Preparation, implementation, monitoring and inspection

Source: Authors

Figure 65: Distribution of IPs and Fols across the clusters of TO3

Cluster 1		Cluster 2		Cluster 3		Cluster 4		Cluster 5		Cluster 6		Cluster 7		Cluster 8	
Business creation and consolidation		Support to entrepreneurship and incubation		Support to internationalisation and visibility		Support to productive capacity		Promoting R&I in enterprises		Productive investment to support SMEs competitiveness		Business services to support SMEs competitiveness		Support to access to finance	

IP code	Average share	IP code	Average share	IP code	Average share	IP code	Average share	IP code	Average share	IP code	Average share	IP code	Average share	IP code	Average share
3a	99.991%	3a	100%	3b	100%	3c	99.999%	3c	99.996%	3d	100%	3d	100%	3c	100%
3d	0.09%					3d	0.001%	3a	0.002%						
								3d	0.001%						

FOI code	Average share	FOI code	Average share	FOI code	Average share	FOI code	Average share	FOI code	Average share	FOI code	Average share	FOI code	Average share	FOI code	Average share
001	99.136%	067	87.957%	066	60.555%	001	99.9735%	075	29.75%	001	99.608%	067	42.995%	067	100%
075	0.422%	082	4.221%	001	17.162%	069	0.0226%	064	25.87%	067	0.128%	066	40.669%		
067	0.226%	066	3.633%	067	8.187%	082	0.0027%	056	24.13%	069	0.096%	075	3.255%		
082	0.059%	072	1.274%	075	5.647%	066	0.0010%	066	9.48%	082	0.042%	069	2.747%		
066	0.053%	068	0.803%	074	3.940%	075	0.0001%	082	3.02%	075	0.031%	064	2.664%		
071	0.026%	034	0.319%	077	1.321%	076	0.0001%	072	2.63%	066	0.025%	074	2.260%		
080	0.020%	073	0.289%	063	1.163%			069	1.70%	071	0.020%	082	1.300%		
064	0.019%	064	0.272%	064	1.043%			076	0.76%	080	0.010%	063	0.737%		
069	0.018%	058	0.243%	082	0.443%			073	0.52%	064	0.010%	098	0.700%		
072	0.010%	077	0.155%	076	0.330%			068	0.47%	072	0.007%	058	0.406%		
068	0.005%	075	0.145%	048	0.064%			077	0.45%	068	0.006%	072	0.404%		
074	0.004%	063	0.124%	069	0.049%			050	0.43%	062	0.001%	093	0.287%		
056	0.002%	074	0.121%	072	0.034%			074	0.32%	065	0.001%	096	0.254%		
		076	0.058%	062	0.023%			063	0.27%	074	0.001%	050	0.214%		
		069	0.054%	101	0.023%			001	0.12%	062	0.001%	001	0.124%		
		001	0.046%	089	0.011%			062	0.06%	004	0.001%	077	0.123%		
		080	0.036%	065	0.004%			030	0.01%	063	0.001%	073	0.112%		
		032	0.033%	122	0.004%			058	0.01%			076	0.105%		
		104	0.029%					071	0.01%			092	0.080%		
		062	0.023%					101	0.01%			104	0.076%		
		031	0.023%									062	0.071%		
		056	0.022%									056	0.069%		
		060	0.020%									071	0.068%		
		071	0.018%									080	0.035%		
		061	0.017%									046	0.033%		
		021	0.016%									090	0.033%		
		055	0.014%									065	0.031%		
		044	0.006%									089	0.022%		
		026	0.006%									060	0.018%		
		059	0.006%									085	0.018%		
		118	0.006%									068	0.017%		
		005	0.004%									003	0.015%		
		004	0.003%									004	0.011%		
		109	0.003%									059	0.009%		
		113	0.003%									091	0.007%		
		122	0.003%									095	0.007%		
		007	0.000%									123	0.007%		
												002	0.004%		
												040	0.004%		
												047	0.004%		
												102	0.004%		
												044	0.002%		
												081	0.002%		
												070	0.001%		

Legend IPs:

3a - Promoting entrepreneurship (new ideas and new firms

3b - New business models for smes (internationalisation)

3c - Advanced capacities for product and service development

3d - Capacity of smes to grow and to engage in innovation processes

Legend Fols:

001 - Generic productive investment in SMEs

002 - Research and innovation processes in large enterprises

003 - Productive invest. in large enterprises linked to LCE

004 - Coop. between large & SMEs in ICT products & services

005 - Electricity (storage and transmission)

007 - Natural gas

021 - Water management & drinking water conservation

026 - Other Railways

030 - Secondary road links to TEN-T road network (new build)

031 - Other national and regional roads (new build)

032 - Local access roads (new build)

034 - Other reconstructed or improved road

040 - Other seaports

044 - Intelligent transport systems

046 - ICT: High-speed broadband (access/local loop; >/= 30 Mbps)

047 - ICT: V-high-speed broadband (access/local loop; >100 Mbps)

048 - ICT: Other types of ICT infrastructure

050 - Education infrastructure for VET & adult learning

055 - Other social infrastructure

056 - Investment in SMEs directly linked to R+I activities

058 - Research and innovation infrastructure (public)

059 - R+I infrastructure (private, incl. science parks)

060 - R+I activities in public research centres

061 - R+I activities in private research centres incl. Networks

062 - Tech-transfer & university-SME cooperation

063 - Cluster support & business networks (SMEs)

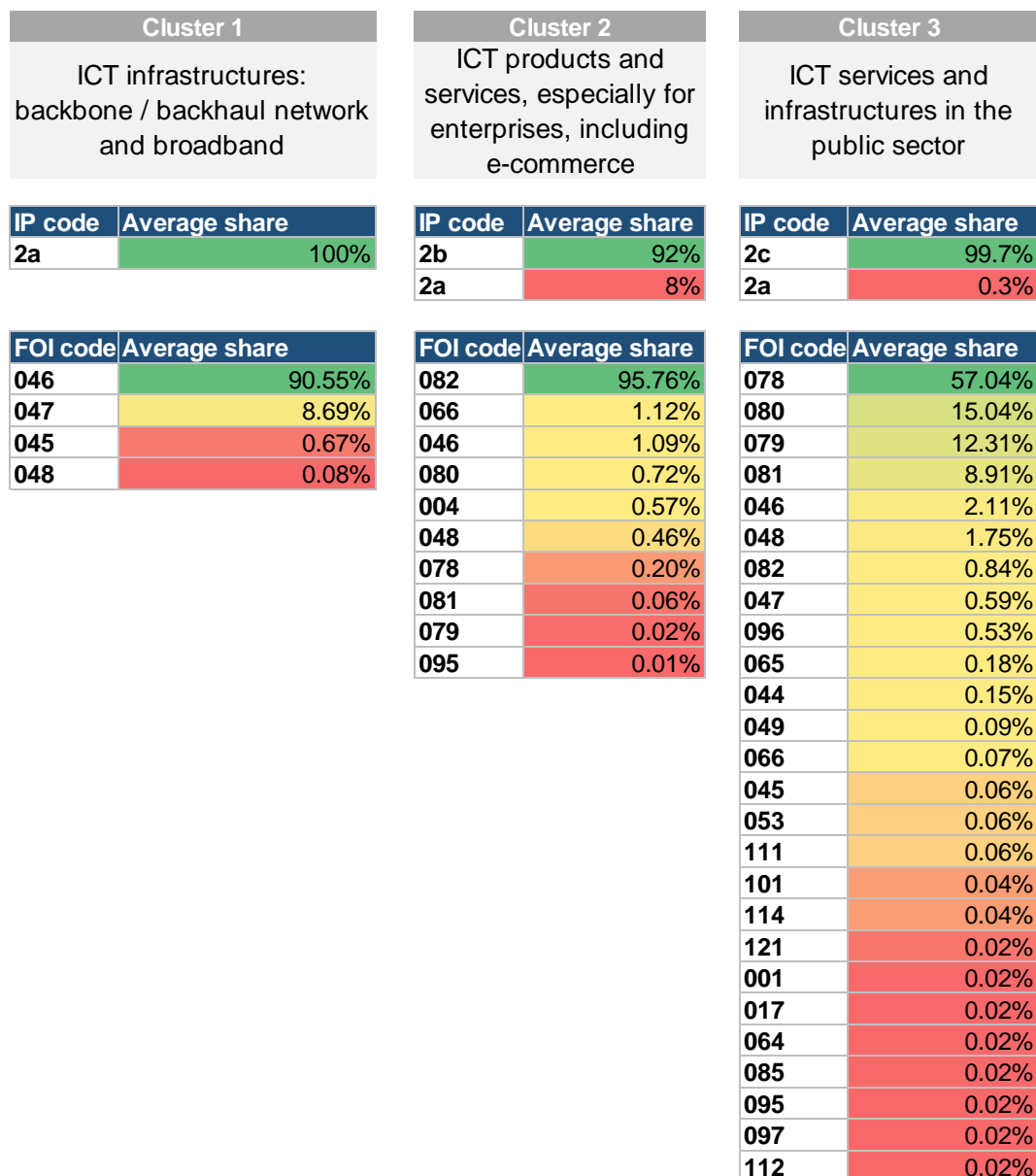064 - R+I processes in SMEs (vouchers, process, design .)

065 - R+I processes, tech-transfer & cooperation in firms on LCE

066 - Advanced support services for SMEs

067 - SME business development, entrepreneurship & incubation

068 - Energy efficiency & demo. projects in SMEs

069 - Support to enviro-friendly production processes in SMEs

070 - Promotion of energy efficiency in large enterprises

071 - Firms specialised in LCE & climate service

072 - Business infra. for SMEs (incl. industrial parks & sites)

073 - Support to social enterprises (SMEs)

074 - Development and promotion of tourism assets in SMEs

075 - Development / promotion of tourism services in/for SMEs

076 - Dev. & promotion of cultural & creative assets in SMEs

077 - Dev. & promotion of cultural & creative services in SMEs

080 - e-Inclusion, e-Accessibility, e-Learning & e-Education

081 - ICT solutions addressing healthy, active ageing & e-Health

082 - ICT Services & applications for SMEs

085 - Biodiversity, nature protection & green infrastructure

089 - Rehabilitation of industrial sites and contaminated land

090 - Cycle tracks and footpaths

091 - Develop & promote tourism potential of natural areas

092 - Protect, develop & promote public tourism assets

093 - Development and promotion of public tourism services

095 - Develop & promote public cultural & heritage services

096 - Institutional capacity of public administrations (ERDF)

098 - Outermost regions: compensation due to accessibility

101 - Cross-financing under ERDF (support to ESF-type actions)

102 - Access to employment & labour mobility

104 - Self-employment, entrepreneurship & business creation

109 - Active inclusion

113 - Promoting social entrepreneurship

118 - Strengthening vocational education & training

122 - Evaluation and studies

123 - Information and communication

Source: Authors

Figure 66:   Distribution of IPs and FoIs across the clusters of TO4

	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6	Cluster 7
	R&I for the development and use of low-carbon solutions	Energy efficiency and use of renewable energy in business production processes	Energy efficiency renovation in enterprise buildings	Energy efficiency renovation in the housing sector	Energy efficiency, smart energy management and renewable energy use in public buildings	Production and distribution of energy derived from renewable sources	Adoption of low-carbon solutions especially in the transport and mobility sector

IP code	Average share	IP code	Average share	IP code	Average share	IP code	Average share	IP code	Average share	IP code	Average share	IP code	Average share
4f	74.39%	4b	96.20%	4b	99.98%	4c	99.99%	4c	99.89%	4a	99.98%	4e	100%
4g	15.82%	4f	3.80%	4d	0.02%	4g	0.01%	4d	0.11%	4d	0.02%		
4d	9.79%												

FOI code	Average share	FOI code	Average share	FOI code	Average share	FOI code	Average share	FOI code	Average share	FOI code	Average share	FOI code	Average share
069	30.99%	069	32.44%	068	100%	014	80.52%	013	99.9%	010	52.20%	043	35.96%
016	15.72%	010	23.13%			010	7.67%	012	0.1%	011	17.89%	090	22.64%
015	10.09%	070	22.36%			016	3.47%			012	14.83%	044	9.95%
065	7.48%	013	4.99%			068	2.13%			068	8.13%	013	9.71%
060	5.31%	067	3.80%			011	1.78%			005	1.61%	083	5.32%
001	4.60%	023	3.53%			087	1.43%			016	1.20%	016	3.08%
071	4.53%	011	2.83%			012	1.03%			065	1.18%	087	2.79%
068	3.74%	014	2.23%			023	0.62%			015	1.16%	023	2.55%
013	2.66%	012	1.80%			043	0.30%			009	0.66%	036	2.13%
003	2.05%	065	1.03%			083	0.30%			013	0.21%	012	1.58%
067	1.77%	071	0.85%			054	0.26%			014	0.19%	096	0.97%
062	1.71%	015	0.34%			044	0.13%			003	0.16%	089	0.84%
058	1.01%	056	0.11%			069	0.08%			023	0.16%	014	0.74%
075	1.00%	003	0.09%			003	0.07%			056	0.16%	034	0.55%
082	0.89%	009	0.09%			015	0.03%			060	0.10%	052	0.36%
064	0.86%	057	0.09%			001	0.03%			057	0.06%	010	0.22%
087	0.81%	001	0.04%			009	0.03%			001	0.04%	085	0.15%
012	0.67%	016	0.04%			071	0.03%			069	0.04%	032	0.08%
066	0.60%	017	0.04%			055	0.02%			051	0.02%	011	0.07%
063	0.59%	043	0.04%			019	0.01%					094	0.06%
011	0.37%	063	0.04%			053	0.01%					001	0.05%
004	0.31%	044	0.02%			065	0.01%					031	0.05%
050	0.31%	060	0.02%			070	0.01%					002	0.02%
010	0.27%					073	0.01%					015	0.02%
014	0.27%					085	0.01%					017	0.02%
056	0.25%					088	0.01%					055	0.02%
002	0.15%											062	0.02%
023	0.12%											064	0.02%
074	0.12%											065	0.02%
092	0.11%											067	0.02%
049	0.10%											122	0.02%
080	0.10%												
079	0.07%												
009	0.06%												
005	0.06%												
018	0.06%												
077	0.03%												
089	0.03%												
070	0.03%												
059	0.02%												
072	0.02%												
081	0.01%												

Legend IPs:

4a - Energy derived from renewable sources
4b - Energy efficiency in enterprises
4c - Smart energy management in public infrastructure
4d - Smart distribution systems
4e - Low-carbon strategies
4f - Low-carbon technologies
4g - Co-generation of heat and power

Legend FoIs:

001 - Generic productive investment in SMEs
002 - Research and innovation processes in large enterprises
003 - Productive invest. in large enterprises linked to LCE
004 - Coop. between large & SMEs in ICT products & services
005 - Electricity (storage and transmission)
009 - Renewable energy: wind
010 - Renewable energy: solar
011 - Renewable energy: biomass
012 - Other renewable energy (hydro, geo, etc) & RE integration
013 - Energy efficiency renovation of public infra. & demo.
014 - Energy efficiency renovation of housing stock & demo
015 - Intelligent Energy Distrib. Systems (incl. smart grids)
016 - High efficiency co-generation and district heating
017 - Household waste mgmt. (incl. minimise, sort, recycle ...)
018 - Household waste mgmt (incl. Mech, Bio, thermal & landfill)
019 - Commercial, industrial or hazardous waste management

023 - Env. measures aimed to reduce/avoid GHG emissions
031 - Other national and regional roads (new build)
032 - Local access roads (new build)
034 - Other reconstructed or improved road
036 - Multimodal transport
043 - Clean urban transport infrastructure & promotion
044 - Intelligent transport systems
049 - Education infrastructure for tertiary education
050 - Education infrastructure for VET & adult learning
051 - Education infrastructure for primary & gen. Secondary
052 - Infrastructure for early childhood education and care
053 - Health infrastructure
054 - Housing infrastructure
055 - Other social infrastructure
056 - Investment in SMEs directly linked to R+I activities
057 - Invest. in large companies linked to R+I activities

058 - Research and innovation infrastructure (public)
059 - R+I infrastructure (private, incl. science parks)
060 - R+I activities in public research centres
062 - Tech-transfer & university-SME cooperation
063 - Cluster support & business networks (SMEs)
064 - R+I processes in SMEs (vouchers, process, design .)
065 - R+I processes, tech-transfer & cooperation in firms on LCE
066 - Advanced support services for SMEs
067 - SME business development, entrepreneurship & incubation
068 - Energy efficiency & demo. projects in SMEs
069 - Support to enviro-friendly production processes in SMEs
070 - Promotion of energy efficiency in large enterprises
071 - Firms specialised in LCE & climate service
072 - Business infra. for SMEs (incl. industrial parks & sites)
073 - Support to social enterprises (SMEs)
074 - Development and promotion of tourism assets in SMEs

075 - Development / promotion of tourism services in/for SMEs
077 - Dev. & promotion of cultural & creative services in SMEs
079 - Access to public sector info. (incl. E-tourism, e-culture)
080 - e-Inclusion, e-Accessibility, e-Learning & e-Education
081 - ICT solutions addressing healthy, active ageing & e-Health
082 - ICT Services & applications for SMEs
083 - Air quality measures
085 - Biodiversity, nature protection & green infrastructure
087 - Adapt to climate change & prevent & manage climate risks
088 - Prevent & manage non-climate related natural risks
089 - Rehabilitation of industrial sites and contaminated land
090 - Cycle tracks and footpaths
092 - Protect, develop & promote public tourism assets
094 - Protect, develop & promote public cultural assets
096 - Institutional capacity of public administrations (ERDF)
122 - Evaluation and studies

Source: Authors

Figure 67: **Distribution of IPs and Fols across the clusters of TO5**

Cluster 1	Cluster 2	Cluster 3	Cluster 4
Environmental risk prevention	Climate-related risks prevention	Management and mitigation of climate change consequences	Investments to manage consequences and prevent non-climate

IP code	Average share
5b	100%

IP code	Average share
5b	100%

IP code	Average share
5a	100%

IP code	Average share
5b	100%

FOI code	Average share
089	61.3%
021	20.4%
085	15.5%
097	2.2%
022	0.6%

FOI code	Average share
087	99.9%
088	0.1%

FOI code	Average share
087	98.5%
022	0.5%
085	0.5%
088	0.3%
014	0.1%

FOI code	Average share
088	99.97%
087	0.03%

Legend IPs:

5a - Adaptation to climate change

5b - Investment to address risks

Legend Fols:

014 - Energy efficiency renovation of housing stock & demo

021 - Water management & drinking water conservation

022 - Waste water treatment

085 - Biodiversity, nature protection & green infrastructure

087 - Adapt to climate change & prevent & manage climate risks

088 - Prevent & manage non-climate related natural risks

089 - Rehabilitation of industrial sites and contaminated land

097 - Community-led local development strategies (ERDF)

Source: Authors

Figure 68:   Distribution of IPs and FoIs across the clusters of TO6

Cluster 1 — Waste management

IP code	Average share
6a	99.8%
6f	0.2%

FOI code	Average share
017	85.27%
018	9.55%
019	4.89%
089	0.14%
022	0.12%
020	0.02%

Cluster 2 — Water treatment and provision

IP code	Average share
6b	100%

FOI code	Average share
022	68.528%
020	29.157%
021	0.523%
018	0.448%
085	0.448%
089	0.277%
084	0.213%
119	0.149%
019	0.107%
121	0.107%
069	0.021%
087	0.021%
023	0.002%

Cluster 3 — Water management and conservation

IP code	Average share
6d	99.4%
6f	0.6%

FOI code	Average share
021	99.76%
022	0.21%
020	0.02%

Cluster 4 — Protecting and restoring biodiversity

IP code	Average share
6d	99.44%
6f	0.51%
6g	0.05%

FOI code	Average share
085	87.04%
086	10.06%
087	0.56%
091	0.51%
090	0.45%
055	0.36%
018	0.25%
092	0.25%
089	0.17%
006	0.15%
094	0.07%
021	0.03%
084	0.03%
088	0.03%
001	0.02%
023	0.02%

Cluster 5 — Protecting, promoting and developing natural and cultural heritage

IP code	Average share
6c	99.97%
6g	0.03%

FOI code	Average share
094	51.13%
091	14.40%
093	11.76%
092	5.87%
095	5.79%
085	2.99%
090	2.98%
097	1.14%
074	0.52%
096	0.52%
086	0.45%
079	0.28%
087	0.20%
018	0.19%
089	0.17%
063	0.16%
021	0.14%
076	0.12%
077	0.12%
075	0.10%
006	0.09%
034	0.09%
042	0.09%
012	0.07%
013	0.07%
055	0.06%
066	0.06%
068	0.06%
088	0.06%
011	0.04%
069	0.04%
001	0.03%
043	0.03%
044	0.03%
083	0.03%
002	0.01%
017	0.01%
023	0.01%
039	0.01%
054	0.01%
060	0.01%
067	0.01%
078	0.01%
118	0.01%

Cluster 6 — Urban regeneration

IP code	Average share
6e	93%
6g	5%
6f	2%

FOI code	Average share
094	30.2248%
083	19.7363%
089	18.7046%
085	9.5990%
069	3.3376%
034	2.3265%
090	2.1656%
023	1.8629%
055	1.7594%
096	1.6300%
092	1.2419%
097	1.1384%
072	0.7146%
087	0.6727%
020	0.6210%
013	0.4916%
019	0.4140%
084	0.3364%
062	0.2846%
021	0.2787%
091	0.2587%
054	0.2329%
119	0.1811%
018	0.1734%
012	0.1294%
022	0.1294%
036	0.1294%
093	0.1294%
017	0.1113%
031	0.1035%
043	0.0880%
066	0.0776%
095	0.0551%
001	0.0517%
011	0.0517%
014	0.0517%
032	0.0517%
063	0.0517%
068	0.0517%
075	0.0517%
015	0.0259%
044	0.0259%
050	0.0259%
056	0.0259%
057	0.0259%
060	0.0259%
064	0.0259%
065	0.0259%
067	0.0259%
079	0.0259%
086	0.0259%
005	0.0135%
007	0.0003%

Legend IPs:

6a - Waste sector
6b - Water sector
6c - Natural and cultural heritage
6d - Biodiversity and soil
6e - Urban environment
6f - Innovative technologies
6g - Industrial transition

Legend FoIs:

001 - Generic productive investment in SMEs
002 - Research and innovation processes in large enterprises
005 - Electricity (storage and transmission)
006 - Electricity (TEN-E storage and transmission)
007 - Natural gas
011 - Renewable energy: biomass
012 - Other renewable energy (hydro, geo, etc) & RE integration
013 - Energy efficiency renovation of public infra. & demo.
014 - Energy efficiency renovation of housing stock & demo
015 - Intelligent Energy Distrib. Systems (incl. smart grids)
017 - Household waste mgmt. (incl. minimise, sort, recycle ...)
018 - Household waste mgmt (incl. Mech, Bio, thermal & landfill)
019 - Commercial, industrial or hazardous waste management
020 - Water infrastructure for human consumption

023 - Env. measures aimed to reduce/avoid GHG emissions
031 - Other national and regional roads (new build)
032 - Local access roads (new build)
034 - Other reconstructed or improved road
036 - Multimodal transport
039 - Seaports (TEN-T)
042 - Inland waterways and ports (regional and local)
043 - Clean urban transport infrastructure & promotion
044 - Intelligent transport systems
050 - Education infrastructure for VET & adult learning
054 - Housing infrastructure
055 - Other social infrastructure
056 - Investment in SMEs directly linked to R+I activities
057 - Invest. in large companies linked to R+I activities

063 - Cluster support & business networks (SMEs)
064 - R+I processes in SMEs (vouchers, process, design .)
065 - R+I processes, tech-transfer & cooperation in firms on LCE
066 - Advanced support services for SMEs
067 - SME business development, entrepreneurship & incubation
068 - Energy efficiency & demo. projects in SMEs
069 - Support to enviro-friendly production processes in SMEs
072 - Business infra. for SMEs (incl. industrial parks & sites)
074 - Development and promotion of tourism assets in SMEs
075 - Development / promotion of tourism services in/for SMEs
076 - Dev. & promotion of cultural & creative assets in SMEs
077 - Dev. & promotion of cultural & creative services in SMEs
078 - e-Government services & applications
079 - Access to public sector info. (incl. E-tourism, e-culture)

085 - Biodiversity, nature protection & green infrastructure
086 - Protect, restorat & sustainable use of Natura 2000 sites
087 - Adapt to climate change & prevent & manage climate risks
088 - Prevent & manage non-climate related natural risks
089 - Rehabilitation of industrial sites and contaminated land
090 - Cycle tracks and footpaths
091 - Develop & promote tourism potential of natural areas
092 - Protect, develop & promote public tourism assets
093 - Development and promotion of public tourism services
094 - Protect, develop & promote public cultural assets
095 - Develop & promote public cultural & heritage services
096 - Institutional capacity of public administrations (ERDF)
097 - Community-led local development strategies (ERDF)
118 - Strengthening vocational education & training

021 - Water management & drinking water conservation	060 - R+I activities in public research centres	083 - Air quality measures	119 - Investment in institutional capacity
022 - Waste water treatment	062 - Tech-transfer & university-SME cooperation	084 - Integrated pollution prevention and control (IPPC)	121 - Preparation, implementation, monitoring and inspection

Source: Authors

Figure 69: **Distribution of IPs and FoIs across the clusters of TO7**

Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6
Multimodal transport in the TEN-T	Regional mobility for the improvement of the TEN-T	Road infrastructure for the improvement of the TEN-T	High quality and interoperable railway systems	Energy efficiency in transport	Environmentally-friendly and low-carbon transport systems

IP code	Average share	IP code	Average share	IP code	Average share	IP code	Average share	IP code	Average share	IP code	Average share
7a	100%	7b	100%	7b	100%	7d	100%	7e	100%	7c	100%

FOI code	Average share	FOI code	Average share	FOI code	Average share	FOI code	Average share	FOI code	Average share	FOI code	Average share
033	24.359%	030	38.773%	034	99.959%	026	57.897%	005	54.610%	043	20.319%
028	18.803%	031	33.994%	031	0.041%	025	15.034%	007	34.752%	090	14.333%
024	17.308%	026	9.457%			024	12.931%	008	7.801%	044	13.556%
029	16.880%	032	4.628%			027	12.759%	006	1.418%	036	9.249%
039	8.120%	044	2.012%			036	0.690%	015	1.418%	040	7.283%
041	3.846%	035	1.610%			044	0.690%			035	7.168%
025	2.991%	040	1.408%							039	5.434%
034	2.778%	025	1.006%							042	4.855%
037	2.137%	027	1.006%							026	3.121%
044	1.709%	036	1.006%							027	2.775%
027	0.641%	034	0.875%							037	2.775%
031	0.214%	039	0.805%							013	2.659%
040	0.214%	042	0.402%							038	1.503%
		043	0.402%							085	1.156%
		069	0.402%							025	0.809%
		085	0.402%							119	0.809%
		119	0.402%							034	0.462%
		013	0.201%							024	0.347%
		024	0.201%							088	0.347%
		029	0.201%							012	0.231%
		038	0.201%							041	0.231%
		041	0.201%							083	0.231%
		090	0.201%							029	0.116%
		094	0.201%							031	0.116%
										094	0.116%

Legend IPs:

7a - Single European Transport Area by investing in the TEN-T

7b - Regional mobility by connecting secondary and tertiary nodes to TEN-T

7c - Environmentally-friendly transport systems

7d - Railway systems

7e - Smart energy distribution, storage and transmission systems

Legend FoIs:

005 - Electricity (storage and transmission)	024 - Railways (TEN-T Core)	031 - Other national and regional roads (new build)	038 - Other airports1	069 - Support to enviro-friendly production processes in SMEs
006 - Electricity (TEN-E storage and transmission)	025 - Railways (TEN-T comprehensive)	032 - Local access roads (new build)	039 - Seaports (TEN-T)	083 - Air quality measures
007 - Natural gas	026 - Other Railways	033 - TEN-T reconstructed or improved road	040 - Other seaports	085 - Biodiversity, nature protection & green infrastructure
008 - Natural gas (TEN-E)	027 - Mobile rail assets	034 - Other reconstructed or improved road	041 - Inland waterways and ports (TEN-T)	088 - Prevent & manage non-climate related natural risks
012 - Other renewable energy (hydro, geo, etc) & RE integration	028 - TEN-T motorways and roads	035 - Multimodal transport (TEN-T)	042 - Inland waterways and ports (regional and local)	090 - Cycle tracks and footpaths
013 - Energy efficiency renovation of public infra. & demo.	029 - TEN-T motorways & roads	036 - Multimodal transport	043 - Clean urban transport infrastructure & promotion	094 - Protect, develop & promote public cultural assets
015 - Intelligent Energy Distrib. Systems (incl. smart grids)	030 - Secondary road links to TEN-T road network (new build)	037 - Airports (TEN-T)	044 - Intelligent transport systems	119 - Investment in institutional capacity

Source: Authors

Figure 70:   Distribution of IPs and FoIs across the clusters of TO8

Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6
Business incubators	Employment-friendly growth exploiting cultural sector and	Social infrastructure for regional and local development	Quality employment and labour mobility	Infrastructure for early childhood education and care	Development of industrial sites

IP code	Average share
8a	99.9%
8c	0.1%

IP code	Average share
8b	100%

IP code	Average share
8b	99.6%
8c	0.2%
8d	0.2%

IP code	Average share
8e	96%
8c	4%

IP code	Average share
8b	82%
8c	18%

IP code	Average share
8b	100%

FOI code	Average share
067	87.170%
104	9.331%
073	1.351%
118	0.737%
085	0.307%
097	0.307%
055	0.246%
095	0.184%
102	0.123%
108	0.123%
072	0.061%
103	0.061%

FOI code	Average share
091	18.566%
076	18.500%
094	17.022%
092	13.858%
069	9.714%
093	8.593%
090	4.390%
074	2.357%
075	1.929%
095	1.857%
058	1.214%
097	1.000%
034	0.429%
077	0.357%
073	0.143%

FOI code	Average share
055	100.000%

FOI code	Average share
102	21.004%
108	20.909%
118	13.636%
104	6.193%
063	5.682%
085	4.924%
117	4.924%
103	4.167%
091	3.409%
106	3.030%
066	1.894%
094	1.515%
112	1.515%
050	1.136%
092	1.136%
109	1.136%
082	0.758%
105	0.758%
034	0.379%
049	0.379%
055	0.379%
080	0.379%
093	0.379%
119	0.379%

FOI code	Average share
052	100.000%

FOI code	Average share
072	100.000%

Legend IPs:

8a - Self-employment, micro- enterprises and business creation
8b - Employment-friendly growth through the development of endogenous potential

8c - Local development initiatives

8d - Employment services

Legend FoIs:

034 - Other reconstructed or improved road

049 - Education infrastructure for tertiary education
050 - Education infrastructure for VET & adult learning
052 - Infrastructure for early childhood education and care

055 - Other social infrastructure

058 - Research and innovation infrastructure (public)
063 - Cluster support & business networks (SMEs)
066 - Advanced support services for SMEs

067 - SME business development, entrepreneurship & incubation

069 - Support to enviro-friendly production processes in SMEs

072 - Business infra. for SMEs (incl. industrial parks & sites)

073 - Support to social enterprises (SMEs)

074 - Development and promotion of tourism assets in SMEs
075 - Development / promotion of tourism services in/for SMEs
076 - Dev. & promotion of cultural & creative assets in SMEs
077 - Dev. & promotion of cultural & creative services in SMEs
080 - e-Inclusion, e-Accessibility, e-Learning & e-Education
082 - ICT Services & applications for SMEs

085 - Biodiversity, nature protection & green infrastructure

090 - Cycle tracks and footpaths

091 - Develop & promote tourism potential of natural areas

092 - Protect, develop & promote public tourism assets
093 - Development and promotion of public tourism services
094 - Protect, develop & promote public cultural assets
095 - Develop & promote public cultural & heritage services
097 - Community-led local development strategies (ERDF)
102 - Access to employment & labour mobility
103 - Sustainable integration of youth into the labour market
104 - Self-employment, entrepreneurship & business creation
105 - Equality between men & women in all areas

106 - Adapting of workers, enterprises & entrepreneurs to change
108 - Modernisation of labour market institutions

109 - Active inclusion

112 - Enhancing access to services

117 - Enhancing equal access to lifelong learning
118 - Strengthening vocational education & training
119 - Investment in institutional capacity

Source: Authors

Figure 71: Distribution of IPs and FoIs across the clusters of TO9

Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5
Health infrastructure	Other social infrastructure	Regeneration of deprived communities	Social infrastructure in deprived communities	Community-led development initiatives for social inclusion

IP code	Average share
9a	99.6%
9e	0.4%

IP code	Average share
9a	100.0%

IP code	Average share
9b	87.8%
9c	7.9%
9e	4.3%

IP code	Average share
9b	96.1%
9f	3.5%
9e	0.3%

IP code	Average share
9d	99.98%
9e	0.02%

FOI code	Average share
053	99.885%
081	0.061%
112	0.054%

FOI code	Average share
055	75.366%
054	12.337%
052	7.754%
073	1.928%
112	1.812%
053	0.221%
081	0.116%
101	0.116%
109	0.093%
114	0.070%
097	0.046%
102	0.046%
013	0.024%
080	0.023%
087	0.023%
103	0.023%

FOI code	Average share
054	32.278%
067	10.078%
052	8.656%
073	7.580%
001	5.943%
017	5.685%
051	4.177%
094	3.962%
034	3.230%
097	3.230%
112	2.498%
020	2.326%
095	1.852%
109	1.464%
083	1.249%
089	1.249%
090	0.775%
101	0.549%
085	0.517%
072	0.474%
113	0.474%
032	0.431%
043	0.431%
053	0.215%
092	0.215%
066	0.129%
014	0.086%
087	0.086%
013	0.043%
050	0.043%
111	0.043%
055	0.033%

FOI code	Average share
055	99.761%
101	0.237%
054	0.002%

FOI code	Average share
097	79.643%
051	16.556%
087	3.067%
114	0.462%
088	0.272%

Legend IPs:
9a - Health and social infrastructure
9b - Regeneration of deprived communities

9c - Social enterprises
9d - Community-led local development

Legend FoIs:
001 - Generic productive investment in SMEs
013 - Energy efficiency renovation of public infra. & demo.
014 - Energy efficiency renovation of housing stock & demo
017 - Household waste mgmt. (incl. minimise, sort, recycle ...)
020 - Water infrastructure for human consumption

032 - Local access roads (new build)
034 - Other reconstructed or improved road
043 - Clean urban transport infrastructure & promotion
050 - Education infrastructure for VET & adult learning
051 - Education infrastructure for primary & gen. Secondary

052 - Infrastructure for early childhood education and care
053 - Health infrastructure
054 - Housing infrastructure
055 - Other social infrastructure
066 - Advanced support services for SMEs

067 - SME business development, entrepreneurship & incubation
072 - Business infra. for SMEs (incl. industrial parks & sites)
073 - Support to social enterprises (SMEs)
080 - e-Inclusion, e-Accessibility, e-Learning & e-Education
081 - ICT solutions addressing healthy, active ageing & e-Health

083 - Air quality measures
085 - Biodiversity, nature protection & green infrastructure
087 - Adapt to climate change & prevent & manage climate risks
088 - Prevent & manage non-climate related natural risks
089 - Rehabilitation of industrial sites and contaminated land

090 - Cycle tracks and footpaths
092 - Protect, develop & promote public tourism assets
094 - Protect, develop & promote public cultural assets
095 - Develop & promote public cultural & heritage services
097 - Community-led local development strategies (ERDF)

101 - Cross-financing under ERDF (support to ESF-type actions)
102 - Access to employment & labour mobility
103 - Sustainable integration of youth into the labour market
109 - Active inclusion
111 - Combating all forms of discrimination

112 - Enhancing access to services
113 - Promoting social entrepreneurship
114 - Community-led local development strategies

x

x

Source: Authors

Figure 72:   Distribution of IPs and FoIs across the clusters of TO10

Cluster 1	Cluster 2	Cluster 3	Cluster 4
Infrastructure for early childhood education and care	Infrastructure for primary and secondary education	Investments for vocational and tertiary education	Promotion of e-Leaning, e-Education and digital literacy

IP code	Average share
10a	100%

IP code	Average share
10a	100%

IP code	Average share
10a	84%
10b	16%

IP code	Average share
10a	100%

FOI code	Average share
052	99.959%
051	0.041%

FOI code	Average share
051	98.338%
054	1.647%
052	0.013%
050	0.001%

FOI code	Average share
050	53.628%
049	25.782%
118	10.354%
117	2.478%
112	2.124%
013	1.652%
109	1.475%
116	0.767%
115	0.442%
104	0.413%
101	0.354%
048	0.230%
012	0.059%
055	0.059%
087	0.059%
106	0.059%
060	0.029%
062	0.029%
080	0.006%

FOI code	Average share
080	100.000%

Legend IPs:
10a - Investing in education, training and vocational training for skills and lifelong learning by developing education and training infrastructure

Legend FoIs:

012 - Other renewable energy (hydro, geo, etc) & RE integration

013 - Energy efficiency renovation of public infra. & demo.

048 - ICT: Other types of ICT infrastructure

049 - Education infrastructure for tertiary education

050 - Education infrastructure for VET & adult learning

051 - Education infrastructure for primary & gen. Secondary

052 - Infrastructure for early childhood education and care

054 - Housing infrastructure

055 - Other social infrastructure

060 - R+I activities in public research centres

062 - Tech-transfer & university-SME cooperation

080 - e-Inclusion, e-Accessibility, e-Learning & e-Education

087 - Adapt to climate change & prevent & manage climate risks

101 - Cross-financing under ERDF (support to ESF-type actions)

104 - Self-employment, entrepreneurship & business creation

106 - Adapting of workers, enterprises & entrepreneurs to change

109 - Active inclusion

112 - Enhancing access to services

115 - Support to early-childhood, primary & secondary education

116 - Access to tertiary & equivalent education

117 - Enhancing equal access to lifelong learning

118 - Strengthening vocational education & training

Source: Authors

Figure 73: Distribution of IPs and FoIs across the clusters of TO11

	Cluster 1		Cluster 2		Cluster 3		Cluster 4		Cluster 5	
	Enhancing efficiency in public administration for Transnational and Interregional		Enhancing efficiency in public administration for Operational Programmes		Enhancing efficiency in public administration for Cross-border Programmes		Promotion of public administration reforms through e-Government services and		Cooperation initiatives to enhance administrative capacities	

IP code	Average share		IP code	Average share		IP code	Average share		IP code	Average share		IP code	Average share
11c	48%		11a	85%		11b	100%		11a	100%		11b	100%
11d	35%		11c	15%									
11a	17%												

FOI code	Average share		FOI code	Average share		FOI code	Average share		FOI code	Average share		FOI code	Average share
119	100%		096	100%		119	99.98%		078	78.9%		120	37.0%
						120	0.02%		087	10.9%		112	10.7%
									055	5.0%		096	9.2%
									053	1.5%		118	7.7%
									081	1.5%		087	7.4%
									120	1.0%		095	4.3%
									088	0.5%		075	3.1%
									121	0.5%		091	2.5%
									122	0.2%		102	2.5%
												107	2.2%
												062	1.8%
												088	1.8%
												060	1.5%
												080	1.5%
												097	1.2%
												044	0.9%
												109	0.9%
												020	0.6%
												079	0.6%
												084	0.6%
												013	0.3%
												043	0.3%
												055	0.3%
												108	0.3%
												115	0.3%
												119	0.3%

Legend IPs:

11a - Enhancing institutional capacity of public authorities and stakeholders and efficient public administration through actions to strengthen the institutional capacity and the efficiency of public administrations and public services related to the implementation of the ERDF, and in support of actions under the ESF to strengthen the institutional capacity and the efficiency of public administration.

11b - Enhancing institutional capacity of public authorities and stakeholders and efficient public administration by promoting legal and administrative cooperation and cooperation between citizens and institutions (Crossborder)

11c - Enhancing institutional capacity of public authorities and stakeholders and efficient public administration by developing and coordinating macro-regional and sea-basin strategies (Transnational)

11d - Disseminating good practices and expertise and capitalising on the results of the exchange of experience in relation to sustainable urban development, including urban-rural linkages pursuant to point (3)(b) of Article 2 (Interregional)

Legend FoIs:

013 - Energy efficiency renovation of public infra. & demo.
020 - Water infrastructure for human consumption
043 - Clean urban transport infrastructure & promotion
044 - Intelligent transport systems
053 - Health infrastructure
055 - Other social infrastructure
060 - R+I activities in public research centres
062 - Tech-transfer & university-SME cooperation

075 - Development / promotion of tourism services in/for SMEs
078 - e-Government services & applications
079 - Access to public sector info. (incl. E-tourism, e-culture)
080 - e-Inclusion, e-Accessibility, e-Learning & e-Education
081 - ICT solutions addressing healthy, active ageing & e-Health
084 - Integrated pollution prevention and control (IPPC)
087 - Adapt to climate change & prevent & manage climate risks
088 - Prevent & manage non-climate related natural risks

091 - Develop & promote tourism potential of natural areas
095 - Develop & promote public cultural & heritage services
096 - Institutional capacity of public administrations (ERDF)
097 - Community-led local development strategies (ERDF)
102 - Access to employment & labour mobility
107 - Active and healthy ageing
108 - Modernisation of labour market institutions
109 - Active inclusion

112 - Enhancing access to services
115 - Support to early-childhood, primary & secondary education
118 - Strengthening vocational education & training
119 - Investment in institutional capacity
120 - Capacity building for ESF stakeholders
121 - Preparation, implementation, monitoring and inspection
122 - Evaluation and studies

x

Source: Authors

Figure 74: **Distribution of IPs and FoIs across the clusters of TO12**

Cluster 1	Cluster 2	Cluster 3	Cluster 4
Technical assistance for the preparation, implementation and monitoring of programmes	Technical assistance for the evaluation of programmes	Technical assistance for the information and communication of programmes	Compensation of additional costs for outermost regions

IP code	Average share		IP code	Average share		IP code	Average share		IP code	Average share
12a	100%		12a	100%		12a	100%		12a	100%

FOI code	Average share		FOI code	Average share		FOI code	Average share		FOI code	Average share
121	99.3%		122	97.7%		123	99.77%		099	91.05%
123	0.5%		121	1.7%		121	0.20%		098	8.27%
122	0.2%		123	0.5%		122	0.02%		058	0.37%
									055	0.05%
									072	0.05%
									096	0.05%
									119	0.05%
									030	0.02%
									086	0.02%
									087	0.02%
									091	0.02%
									097	0.02%

Legend IPs:
12a - Not applicable (Technical assistance only)

Legend FoIs:

030 - Secondary road links to TEN-T road network (new build)

055 - Other social infrastructure

058 - Research and innovation infrastructure (public)

072 - Business infra. for SMEs (incl. industrial parks & sites)

086 - Protect, restorat & sustainable use of Natura 2000 sites

087 - Adapt to climate change & prevent & manage climate risks

091 - Develop & promote tourism potential of natural areas

096 - Institutional capacity of public administrations (ERDF)

097 - Community-led local development strategies (ERDF)

098 - Outermost regions: compensation due to accessibility

099 - Outermost regions: compensation costs due to market size

119 - Investment in institutional capacity

121 - Preparation, implementation, monitoring and inspection

122 - Evaluation and studies

123 - Information and communication

Source: Authors