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# APPLICATION AREAS OF GIS FOR THE INVENTORY AND MONITORING OF VACANT BUILDINGS AND FLATS

ALT/BAU Urbact project  
thematic report

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# Introduction

This report presents the different GIS tools available in the ArcMap program and its application areas for the inventory, monitoring and marketing of vacant places. The structure of the report follows the key steps of the 'Housing agency' good practice and suggests GIS techniques which can support the transfer of the good practice into the ALT/BAU partner cities.

From the 7 key activities of the good practice, for 4 activities GIS solutions can be applied.

More concretely, ArcMap program offers GIS tools for identifying vacant buildings, identifying focus areas, defining priority buildings and implementing focused marketing of the buildings.

# 1) IDENTIFICATION OF FOCUS AREAS AND BUILDINGS IN NEED

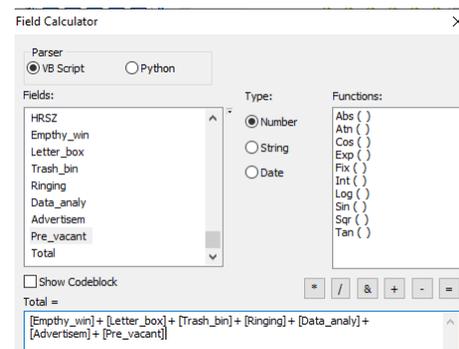
## *1.1. Identifying buildings*

The 1st step in the adaptation of the 'Housing agency' good practice is the inventory of the vacant buildings. The Transferability Study offers several tools for identifying vacant places, however it is emphasized that none of these tools can have 100% sure results, therefore the information collected from several sources related to buildings should be jointly investigated for which GIS can provide tools, especially if we are talking about hundreds or thousands of buildings.

The example of an 'imaginary city' can be taken who is partner in ALT/BAU and would like to adapt the good practice. In this city some GIS data are already available and also some of the tools of identifying vacant buildings have been already applied. For the suggested GIS analysis, first, a land registry map is needed as a vector layer (ideally already in shp format) including polygons as buildings/plots including a number of geo-referenced information (address, plot number, plot size, categories etc.) The 'city' has already organized site visits checking whether there are buildings having empty windows, nameless door bells and letterboxes, empty letter boxes or full of advertisement, empty trash bins. The result of the site visits is included into the attribute table of the GIS layer related to each building/plot (see below the attribute table in ArcMap). This table can also include available knowledge from other departments of the municipality (tax, conservation, building control) and infrastructure providers (water, electricity, data crossing of these), if available.

FID	Shape *	Emphy win	Letter box	Trash bin	Ringing	Data analy	Advertisem	Pre vacant	Total
0	Polygon ZM	1	0	1	0	0	1	0	3
1	Polygon ZM	0	1	1	1	1	1	0	5
2	Polygon ZM	0	0	0	0	0	1	1	2
3	Polygon ZM	0	0	0	0	0	0	0	0

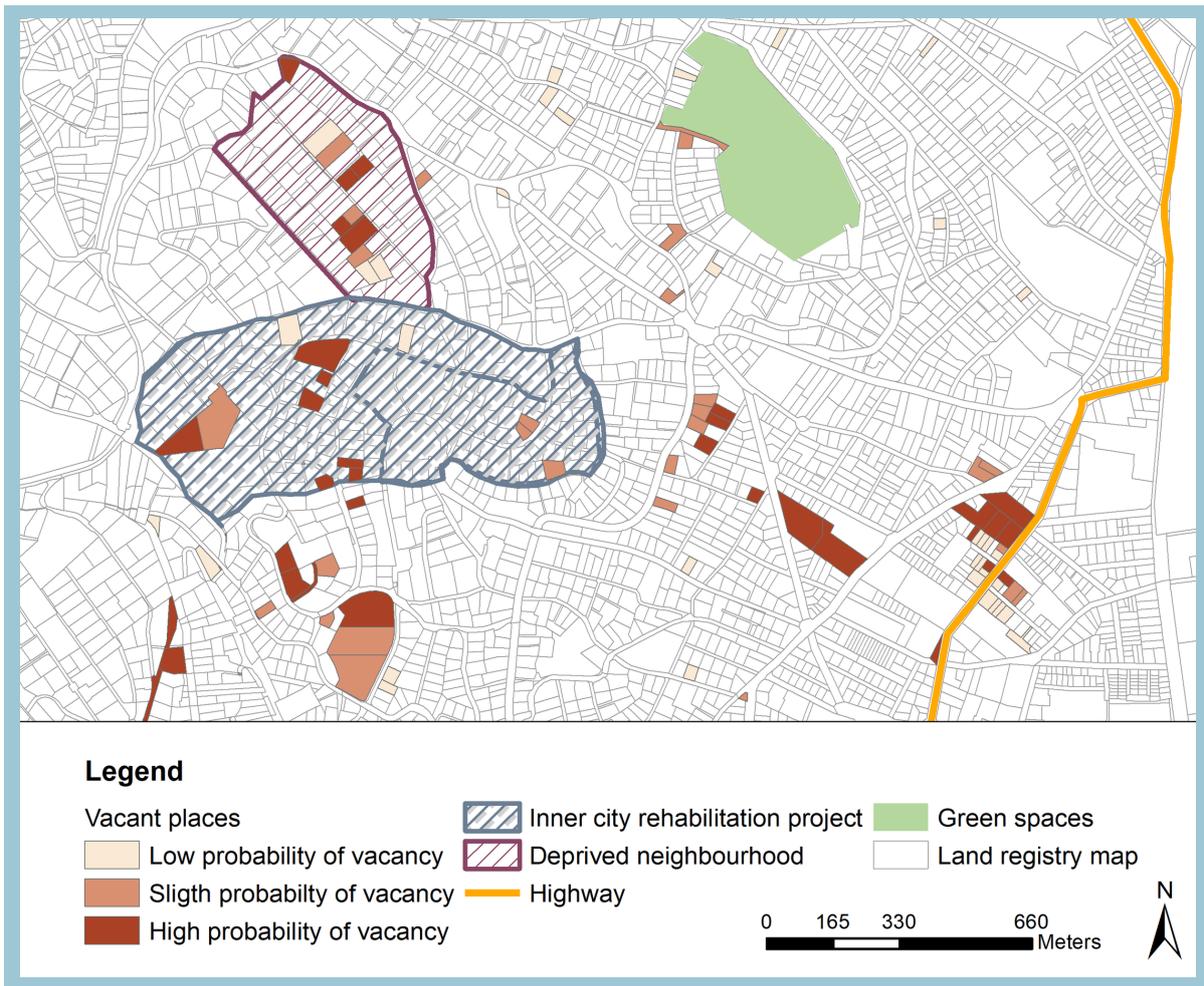
Also, the results of data analyses are included into the table as well as the result of checking advertisements in newspapers. 0 or 1 values are included into the table indicating that according to the information sources is the building vacant or not. As many buildings are partly empty or only single flats are vacant, you might need to work with other values than 0 and 1. For instance, instead of giving 1 for empty letter boxes, indicate that 3 letter boxes of 3 flats are empty which suggest that the 3 flats are empty in that building. It is possible in ArcMap to make calculations with the data in the columns of attribute tables of layers. For instance, we would like to give more significance to the site visit results than the data analyses, so we multiply by 0,7 the data in column of data analyses. This way while positive site visit result receive 1, data analyse result receive only 0,7 value as site visit gives more reliable information than data analyses or other way around if this is the case in your city.



Finally, we cumulate the values of all columns (site visits, data analyses etc), this way each plot or building will have a cumulated value (see Total column in the table above and Field calculator window in the right) which can be visualized on a map.

There is different type of classification methods in ArcMap for the visualization of values. It is worth to make classes for the group of values. This way on the map we can see which group of buildings have the highest probability of being vacant.

Of course, the whole calculation can be also easily implemented in Microsoft Excel, but the visualization of each column separately and the visualization of the cumulated values can provide additional information for map readers by analysing the possibly vacant places in their urban context. The map reader having basic knowledge about the city will be able to select those areas of buildings which are the most likely to be vacant. The visualization of other urban elements is also suggested to be included into the map like road network, greens spaces, water bodies, protected areas, public owned buildings, district borders, borders according to the function of the neighbourhood etc. (see the example map below about the 'imaginary city').



It can be also an interesting aspect to include into the map the significant investments recently implemented in the city which could have negative or positive influence on vacancy (see map above). For instance, a highway has been built next to a block house which further decreased the value of the flats; or a large-scale inner-city rehabilitation project was implemented which increased the attractiveness of the area so it is expected that the demand for flats in the inner city increased which should decrease the probability of vacancy. It can provide additional information if we check whether there is any other vacant buildings in close of our investigated buildings. Is it a typical area of vacant places so it is likely that the one about which we are not sure to be vacant is also vacant. Also, the average real estate prices of neighbourhoods worth to be presented on our map which has influence on vacancy. All these aspects are recommended to be jointly visualized on our possibly vacant places map to have a full picture or the aspects can be thematically grouped visualizing those aspects together which influence each other. That is what GIS can provide compared to an Excel table or other data analysis program with pure data about vacant places.

The database should be regularly updated including additional columns with values for a specific data collection period. If a series of information is already available for a longer period, it can serve as information for the current analysis. If a building for instance was identified as vacant for the last 3 times of data collection it can be likely that it is vacant also now. This can be added into the attribute table as a new attribute in a new column. However, if a building/flat appears empty in the latest dataset but not now, it can also mean that it was only temporarily empty.

GIS can also support data collection at site visits by filling in online field survey by mobile device, for instance by QGIS. The steps of creating field survey have already presented in one of the ALT/BAU meetings, and also available in details here:

<https://www.lutraconsulting.co.uk/blog/2020/02/14/survey-qgis-input/>

## INVENTORIES OF ALT/BAU PARTNERS

**Chemnitz:** Presentation about the Monitoring of the work of the Agency.

**Constanta (RO):** Meeting presentation about GIS database for the Peninsula;

[https://primariact.maps.arcgis.com/apps/PublicInformation/index.html?](https://primariact.maps.arcgis.com/apps/PublicInformation/index.html?appid=4c2025d786d94f54aa6999e023b20668)

[appid=4c2025d786d94f54aa6999e023b20668](https://primariact.maps.arcgis.com/apps/PublicInformation/index.html?appid=4c2025d786d94f54aa6999e023b20668)

**Riga (LV):** city's GIS and web-based inventory of dilapidate buildings: <https://grausti.riga.lv/>

**Rybnik (PL):** Inventory is being done and supposedly linked to the city's GIS database. Current status unknown.

**Seraing (BE):** Presentation about applying QGIS

**Turin (IT):** Urban Lab (partner) with mapping as a core issue of their work (example:

<http://www.urbancenter.to.it/torino-atlas-mappe-del-territorio-metropolitano-3/>) but no specific mapping of vacant flats

**Villafranca (ES):** Inventory is being done and supposedly linked to the city's GIS database. Current status unknown.

**WORKSHOP SUMMARY:** Inventory and monitoring of vacant buildings

## 1.2 Identifying focus areas

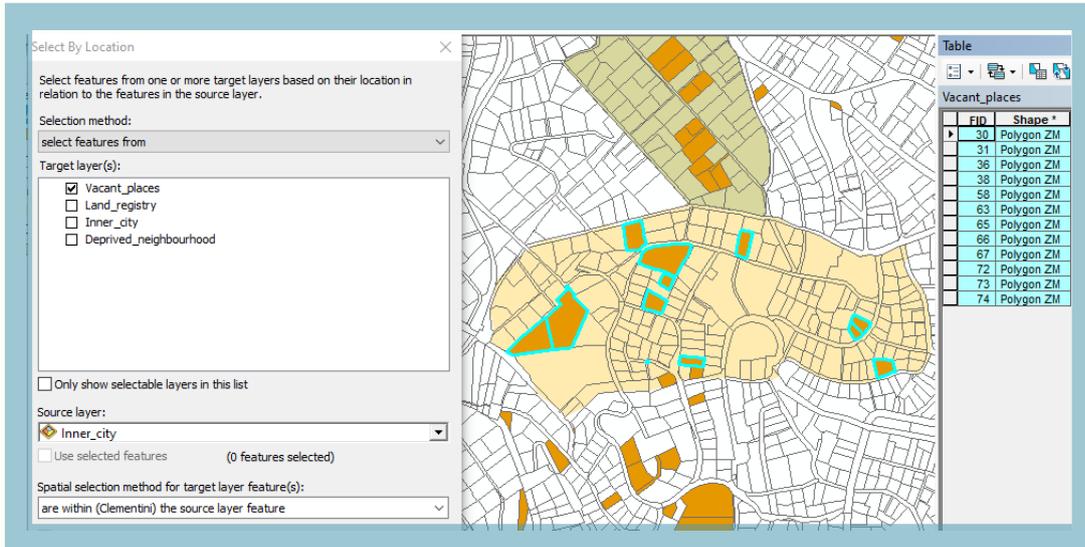
After identifying the vacant buildings in the highest probability, the next step is to identify focus areas where the good practice can be first tested. According to the Transferability Study, there are two main criteria of identifying focus areas:

- Areas with high amount or rate of vacant buildings and flats
- Important city areas (i.e. city centre, deprived neighbourhoods, focus areas in urban development concepts)

Partners have already identified their most important focus areas in the Transferability Study, however for future work applying the good practice for additional neighbourhoods and for other cities outside the ALT/BAU partnership, the GIS methods suggested here can be effectively applied. There are four ways to identify focus areas by GIS which meet both criteria:

### **By Select by location function for option 1: One or two city area selected having pre-defined border**

As a first step, polygons are created around the important city areas in ArcMap producing separate map layers for each area if they do not yet exist in the municipality's GIS system. Also the vacant places layer are opened in ArcMap and visualised jointly with the selected city areas. By the *Select by location* function of ArcMap, we can select those vacant places polygons which are inside and intersect with the important city areas polygons. The selected vacant places can be seen listed in the attribute table of the vacant places layer and can be exported as a separate list which includes only those places which we would like to work on. If we have more than one important city area, we can check which city area includes the most vacant places in absolute and relative numbers by applying the *Statistics* function in their attribute table where the number of polygons selected can be calculated.



## By Extraction tools for option 2: all city areas (districts) are tested having pre-defined border

If you do not have specific city area in mind, but you would like to know which city area/district/neighbourhood has the highest number of vacant places, you can apply extraction tools in ArcMap (*Clip*, *Union*). This way vacant places are extracted according to the area where they locate. However, it is a more complicated method suggested to be used if there are lot of city area/district which should be investigated.

## By Buffer tool for option 3: no selected city area(s) with predefined border

If you do not want to select focus area according to predefined district or neighbourhood borders, but you would like to find the area where the most vacant places locate close to each other looking for the most problematic area, you can test the *Buffer tool* in ArcMap (see map below). You can make for instance a 50 m buffer around vacant places polygons creating polygons around each vacant places, merge those polygons which touch each other (*dissolve*), and calculate the area of the merged buffer polygons. Finally select the biggest merged polygon which is likely to include the most vacant places.



### **By Hotspot analysis for option 3: no selected city area(s) with predefined border**

If you are advanced in using ArcMap, it is an elegant option to apply *Hot Spot analysis* to identify focus area. (*Spatial Statistics Tools – Mapping Clusters – Hot Spot Analysis*).

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## 2) COLLECTING RELEVANT DATA OF THE BUILDINGS/ MONITORING

### *2.1 Defining priority buildings*

Following the identification of the focus area, several relevant information are collected about the buildings inside the area. Based on the data collected, priority buildings are defined. In the 'Housing agency' good practice buildings were prioritized according to the following criteria:

1. structural condition / degree of rehabilitation need
2. urban / neighbourhood significance
3. heritage value
4. size of the building
5. area located
6. duration of vacancy
7. interest of private investor / owner
8. development opportunities

Applying the data collected, in ArcMap it is possible to evaluate all the vacant places how much they meet these criteria. By GIS tools, it can be easily identified that which vacant places have the highest reactivation potential and need. As the first step, spatial indicators are generated which are able to represent each criteria in a GIS analysis. Indicators generated are highly depends on the availability of data about the buildings and availability of other GIS data at the municipalities, however some general indicators has been drafted and included into the table below which can be applied as bases for generating city specific indicators.

# POTENTIAL AND NEED FOR REACTIVATION

## *Criteria - Spatial indicators*

### **Structural condition/degree of rehabilitation need**

Degree of rehabilitation need/Condition categories  
 Time of last renovation  
 Need for emergency intervention  
 Technical/Energetic condition of the construction elements  
 Specific condition: having elevator

### **Urban/neighbourhood significance**

Located in the historic city centre/in priority intervention zone/specific streets/district under regeneration/redevelopment areas/areas with high number of listed buildings  
 Important element of urban structure: Neighbouring building locates in 1 m distance/Corner buildings/Buildings on square being visible  
 Aecessability of services and transport

### **Heritage value**

Listed building  
 Level of protection  
 Not listed but having heritage, architectural value  
 Locates in protected garden or heritage building complex

### **Size of the building**

Size categories (m2, number of flats, floors, commercial ground floor)

### **Area located**

Areas with low noise pollution/Areas located not close to roads having high traffic  
 Areas locate close to public transportation, cycling roads  
 Close to parks, services  
 Close to the inner city  
 Locate in residential area/touristic area/ commercial area/recently renovated neighbourhoods/deprived neighbourhoods

## Criteria - Spatial indicators

### Duration of vacancy

Time categories - the price of rehabilitation increase with time degradation high value applied for longer vacancy as the need for rehabilitation is urgent, however the potential for reactivation is lower for longer vacancy. Contradictory indicator if we analyse reactivation need and potential in the same time.

### Interest of private investor / owner

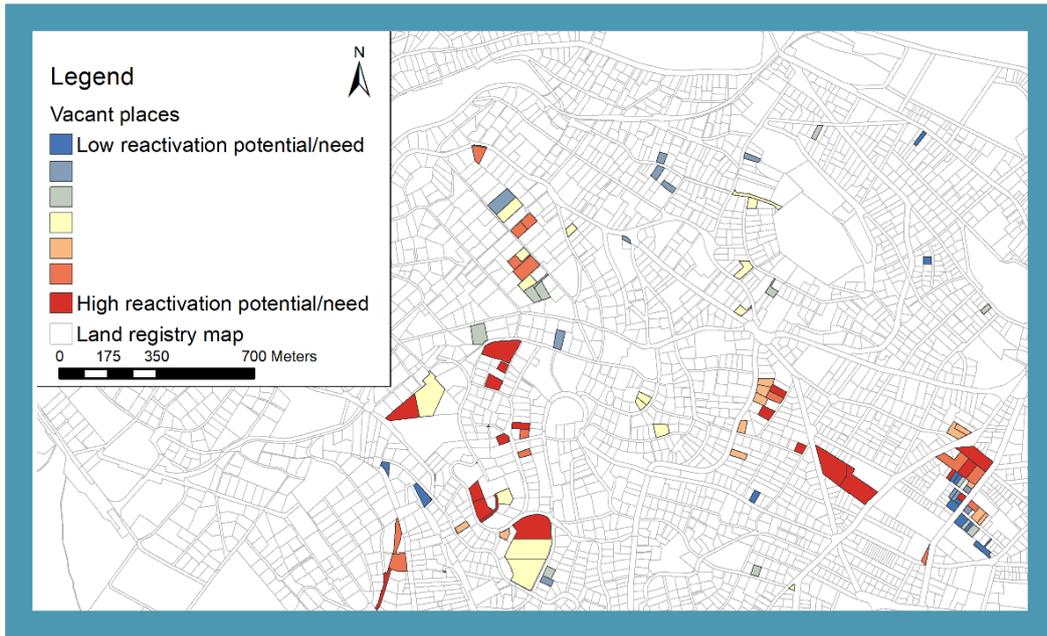
Number of potential buyers per month, also city departments and other stakeholders who contacted the owner in the last year  
Image of the area where vacant places locate

### Developing opportunities

Available grants for refurbishment, energy improvement, accessibility etc  
Potential for cultural and social uses  
Mix of functions

Based on the indicator values a multi-criteria analysis can be implemented which take into consideration all the criteria in the same time producing a map presenting the vacant places having highest and lowest reactivation potential and need.

The technical implementation of the analysis starts with including the indicator values (1 to 5) into the attribute table of the vacant places layer (as it was explained in 1.1). In a total column the values can be cumulated and can be visualized on a map after classification. The map shows that which buildings have the highest and lowest reactivation potential and need (see map below).



The specific indicators of course can be also separately presented on separate maps visualizing the heritage buildings, the size of the buildings, the duration of vacancy etc. All can have added value in the understanding of the reasons and consequences of vacancy. Again, this analysis (except the mapping part) can be also implemented in Microsoft Excel, however for the calculation of the size of the building, area located, and urban/neighbourhood significance criteria, GIS offer some useful tools:

- Calculating the *Size of the building*: if a vector layer is available including the vacant buildings as polygons in ArcMap, by the *Statistics – Area tool*, you can calculate the size of the buildings (however, unfortunately it is not possible to calculate this way the size of the flats in a building)
- GIS layers often available about the function of the areas whether they are recreational, industrial, residential function, intensive residential function areas. If our priority is the residential function areas, we select those vacant buildings which locates inside these areas by the *Select by location* function explained in 1.2.1 and we give higher value to these buildings in the multi-criteria analysis while giving lower values for those who locate for instance in industrial areas.

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- The *Select by location* tool can be applied also for Urban/neighbourhood significance criteria if we are interested in whether the vacant buildings contribute to the inner urban density, (therefore the demolition should be avoided) or not. In this case we select those vacant buildings which have other buildings in 1m distance and locates in the inner city.

On top of these tools which make the analyses easier, there is also the opportunity to use it as a joint database in contrast to using individual/multiple excel files.

## 3) CONTACTING THE OWNERS OF BUILDINGS

### 2.1 Defining priority buildings

At the stage of contacting the owner of the selected buildings, more data can be collected about the buildings which should be included into the GIS database. These data can be applied in marketing the building and can add to the multi-criteria analysis described before.

**WORKSHOP SUMMARY:** [Identifying, activating and supporting owners of vacant buildings and flats](#)

[OWNER QUESTIONNAIRE](#) and [example](#)

## 4) MARKETING THE BUILDING

### 2.1 Defining priority buildings

GIS can also support marketing the buildings by implementing a multi-criteria analysis applying the above explained selection functions of ArcMap:

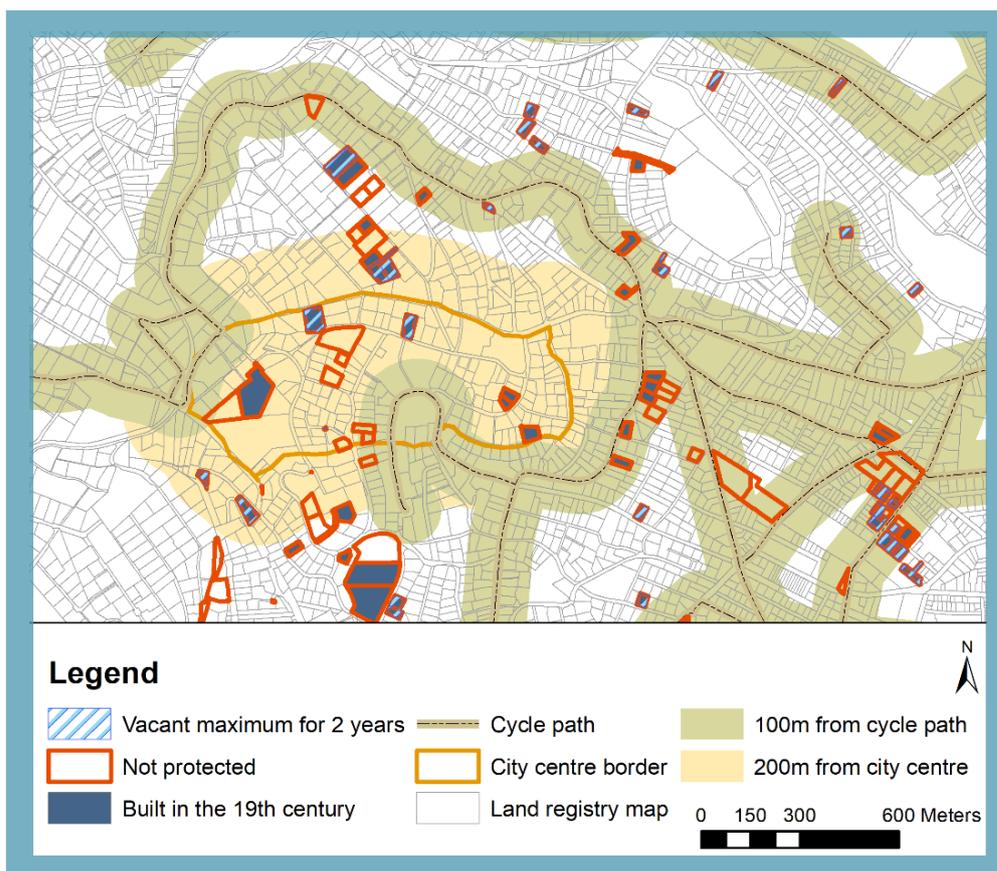
**WORKSHOP SUMMARY:** [Identifying, activating and supporting potential buyers and investors for the reactivation of vacant buildings and flats](#)

[BUILDING AND FOCUS AREA PROFILE tips](#)

## Targeting specific investor

We can easily select and present those buildings to investors/potential buyers which meet their specific requirements. For instance, an investor would like to find a building which locates in maximum 200 m distance from the city centre, accessible by cycling path, built in the 19th century, but not protected, being abandoned maximum for 2 years. In ArcMap a multi-criteria analysis can be implemented by applying the *Select by attribute* and *Select by location* functions.

First, by *Select by attribute* and applying the data we collected about the buildings, those ones are selected from the attribute table of the vacant buildings layer which built in the 19th century, but not protected and being abandoned maximum for 2 years. The selected buildings saved as a separate layer. Following, by the *Select by location* function, those buildings are selected which are in maximum 200 m distance from the city centre polygon layer and 100m distance from the cycling path polyline layer (see map below).



If we would like to be more realistic, we can apply the *Service area network analysis* of ArcMap which make possible to calculate distances on road network. The result of such analysis is a polygon from 200 m distance from a specific point on a network. In our case we could have a polygon from 200m distance from the city centre and we apply this polygon in the *Select by location* function to find those vacant buildings which are inside this service area polygon, therefore in 200m walking distance from the city centre.

### **Targeting specific group of investor**

If we have general knowledge what the specific group of investors are looking for, we can make pre-selections by ArcMap and approach the different group of investors only with those buildings which are likely to raise their interest. Separate maps can be created for each investor type including the buildings they can be interested in. It is also worth to include into the map additional urban elements which highlights the potential of the buildings for development. The database can help the automated creation of profiles for each building including information, pictures and maps. A very relevant point for 2) and 3) is the fact that digital versions can be provided which can be continuously updated and can be available online.

# Chemnitz

**Private developers usually from outside the city**

Listed buildings

Larger buildings

Clusters: select and highlight those buildings whose border intersect with other vacant building

Small/medium sized places

Locates inside the border of urban redevelopment areas (funds)

**Local investors, often craftsmen, companies or individuals (long-term owners)**

**GGG, the city's housing company**

Central location: inside or in ...m distance from central areas/districts

Clusters with other buildings owned

Option for redevelopment grants: inside a redevelopment area

**Co-housing projects (e.g as cooperatives) (long-term owners)**

Good accessibility: distance from public transport, cycling path etc.

Locates in low traffic street or not in busy road, not in ..m distance of busy road, not along bus line road

Good building condition

# Constanta

**Universities providing student housing**

Size:50-100m<sup>2</sup> buildings

Location: maximum 200m distance from the university campus; at least 500 m distance from the city centre,

No heritage building

In very good condition

**Private single investors**

Degraded building to rehabilitate

Residential and commercial place in the same building: live in an apartment and run a business in the commercial space

**Profit driven project developer**

Degraded building to rehabilitate

# Rybnik

## Private single investors

Size: small 1-2 room apartments (25-40m<sup>2</sup>) or studios for students and working single tenants  
Locates inside the city centre

## Young people/families to build home ownership

Size: 2-3 room apartments (45-70m<sup>2</sup>)  
Close to green areas – in ...m distance zone of green spaces  
Access to parking places (inside fee parking zone)

## Profit driven project developer

Size: small 1-2 room apartments (25-40m<sup>2</sup>) or studios for students and working single tenants;  
Bigger apartments (50, 70 or more m<sup>2</sup>) which can be easily refurbished and divided on „subapartments“ - to increase the number of rooms and WC's inside.  
Locates inside the citycentre

# Seraign

## Private investors for own use or for investment to sell or rent once renovated

Locate in....m distance from city centre border  
Locate in ....m walking distance on road network to specific type of schools/shops  
Analysing how many and what type of shops are in ....m walking distance  
Locate in....m walking distance on road network to from bus/train stops and stations

# Turin

**Private bank foundations investing in social impact actions (temporary housing, social housing);**

**Universities and regional institutions to provide residences to their students;**

**Co-housing projects (e.g as cooperatives) (long-term owners)**

Accessibility to the city centre – locates in ...m distance from public transportation/..m walking distance from city centre border  
Infrastructural network  
Presence of different public services within 500 m distance

# VILAFRANCA DEL Penedès

**Fundació Hàbitat 3**

**Incasòl**

**Agència de**

**l'Habitatge de Catalunya**

**Llar Unió Catalònia SL**

## Targeting general audience

Finally, the produced maps about the multi-criteria analysis can be included into factsheets of vacant buildings, can be uploaded to market, city websites, social media, included into feasibility studies, presented in property market fairs, information workshops or at Vacant buildings street festivals. In these cases it is crucial to include an explanation about the maps helping readers to understand what they see on the map. A few tips and hints are collected here how to analyse a map produced based on a multi-criteria analysis:

- Highlight the buildings which have the highest value and the lowest value.
- Look for the reasons behind these extreme values looking into their attribute table: due to which criteria their total value is that high or low. Is there any mistake behind these extreme values or are they correct and they need indeed priority in reactivation?
- Explain how the criteria might reinforce each other or made a contradictory effect on each other.
- Make general conclusions about the buildings: are they mostly heritage building, mostly locates in inner city etc.
- Select a building which you know well and check whether your knowledge is in line with the value this building received in the analysis. It can reassure you that you made a correct analysis.

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# WORKING WITH GIS

## *expertise, software, challenges*

In order to be able to implement the above listed analyses and confidently use the suggested tools, you will need some expertise in using ArcMap. Especially if you want to go beyond data collection and data visualization (still can require GIS expertise) and go to the level of ANALYSIS by GIS tools explained in this report, external GIS expertise and preferably also urban planning experience are necessary. The program required for the presented analyses is ArcMap

(<https://desktop.arcgis.com/en/arcmap/latest/map/main/what-is-arcmap-.htm>) which is a mapping and spatial analytics software built by Esri. ArcMap can be bought from Esri through: <https://www.esri.com/en-us/store/products/all?productType=Core>

Beside ArcMap, cities often work with Mapinfo and QGIS to implement GIS analyses, while they use different software for storing and updating data. These software are operated by external enterprises and continuously developed according to the need of the municipalities. (see practice of Budapest – Minerva below). For collecting data from citizens by map-based surveys, a third type of software is often applied, for instance Maptionnaire (<https://maptionnaire.com/>) (see practice of Espoo below).

There are a number of challenges one might need to face working with GIS, however there are 3 which can be expected implementing the presented analyses:

**Data challenge:** the availability of quality data is crucial at analyses. As an old GIS expert said: "if you put in trash you receive trash" :) Furthermore, the form of data also important, it is always easier if the municipality regularly produce GIS (shp) layers which you can use in your analyses working on vacant places and you do not need to start from digitalization. Data security is also an issue if personalized data are collected.

**Generalization challenge:** another wise talk is “mapping is the generalization of the real world” which is resulted in the challenge of making generalization on a way to do not distort the truth of the world:

- finding the right indicators which represent the attributes on the best way
- classification challenge: you can present your data with different type of classification method, however it is crucial to find that method which shows the 'truth' and make sense, do not distort data by inappropriate classification

**Ranking challenge:** you might face this challenge implementing multi-criteria analyses when you need to decide how much significance you give to different criteria in your analyses.

**Cooperation challenge** among the stakeholders inside and outside the city administration on how to maintain and apply the database.

**Maintenance and monitoring challenge:** capacity and resources must be provided for the maintenance of the database by regularly monitoring the changes occur and continuously updating the database if information is received about any changes.

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# THEMATIC USE OF GIS IN CITY ADMINISTRATION

In order to present practices of the operation, maintenance and thematic use of GIS in city administration including the application areas and cooperation mechanism working on and applying GIS database, 3 practices from 3 European cities were selected and interviewed:

## ***Practice of 12th district of Budapest and Minerva GIS system, Hungary***

The 12th district of Budapest is one of the 1st municipalities in Hungary who maintain an own GIS system. This GIS database was built up by a Hungarian small enterprise who was originally contracted to create the database to be able to prepare a digital settlement development plan. After investing significant time and resources into building up this database, it was concluded that it should be maintained and applied to support the daily work of the municipality. A long-term contract has been created with the enterprise who developed the system into an online platform, created the method of maintenance, which is the key of the applicability of the system, and organized trainings for municipality officers how to use the platform. It took 2-3 months to build the system. The time-consuming part was to develop data (they have visited each building in the district). Also, during maintenance, the demanding part (expensive and lot of time) is to develop digital data from non-digital ones (maps drawn by hand..) and paying for orthophotos.

Key point of its maintenance that it is updated on daily bases.

Officers from all municipality departments have to only send an email (must be in written form, phone call is not enough) to the responsible person at the enterprise when any changes occur, and this person make the change immediately in the system.

It was understood by the leaders of the municipality that officers do not have the capacity to update the platform themselves, so the municipality must pay to the enterprise to do that. Some data though updated directly by officers, but the person at the enterprise also informed about the changes. Officers, and department directors has different level of access and rights to the system. The platform is also available for citizens however obviously with less information and function:

<https://minerva.bp12ker.hu/minerva/bp12ker/internet.php> The system and its data is owned by the municipality but this external enterprise had to be contracted to ensure the maintenance of the system which requires not only GIS expertise but also IT programmer expertise, and the municipality cannot employ a programmer just for this task, it is more economical to contract a company who has IT expertise. As data is owned by the municipality, the enterprise cannot use it for other purposes or share with anybody only if the municipality specifically ask for.

The following layers are included into this database: land registry map, orthophoto taken every 2 years since 2003, regulatory plan, capital level and agglomeration level plans, natural and monumental protected areas and places, buildings, forestry, water bodies, karst areas, safety distances, ownership, construction ban, repair obligation, tree cadastre (species, theoretical value), clerks' area, institutions and their districts, selective waste collection, polling stations, sewerage, traffic technology, parking places, road network, utilities, address of people with special care, their doctor, relatives, caregiver, advertising equipment register, companies requiring notary approval.

The database supports the daily operation of the municipality in the following ways:

- It most frequently used by the chief architect's office deciding to where and where not allowed to build and for planning and developing projects. For instance, if a leader/director must make a quick decision about a land parcel or building, he/she can check in the database where several information is available.

- It is also applied for recording potholes of roads. The database is joint to a mobile application which helps collecting information about potholes. If a hole is found, it is registered in the application which automatically send an email to the municipality office and to the company who built that road and if they are inside the guaranty period, the company is required to prepare the hole.
- The database also supports urban green spaces' management.
- Can be applied for creating school districts based on the number of 6-8 years old children living in the closeness of the school.
- It was also a way of application when a bomb was fund, and it was calculated that in 300m of the bomb from which buildings people must be evacuated

### ***Practice of the Municipality of Espoo, Finland***

Espoo being one of the biggest city of Finland have a quite advanced GIS system (<https://kartat.espoo.fi/IMS/en/Map>) and apply GIS in several fields of their work. The whole city is available in a 3D model as digital twin including 6 - 7000 datasets which are continuously developed including new datasets.

For instance, they have dataset for land ownership, infrastructures, tree cadastre, natural environment, protected species, water quality, cultural values related to physical environment etc.

Espoo use a software for storing data which was developed by an external enterprise. Also, the enterprise is responsible for updating the database and developing new functions if requested by the municipality. Some data is automatically updated by the Finish National Statistical Office as the system of Espoo is connected to this centralized system of the Statistical Office, thus if a data is updated there, it is also updated in the database of Espoo. Data also regularly collected from citizens through the MyEspoo webpage where map-based questionnaires are conducted with citizens about their experiences using the city and about the values of the city. All these qualitative data are included into the GIS database and applied for planning developments. Also, Maptionnaire software is used to conduct map-based questionnaire with specific group of citizens before any investment or action started in the city by the municipality.

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For instance, Espoo asked kindergartens to fill an online map-based survey in Maptionnaire about which forest areas are visited by children groups. The result was fed in the database and when the forestry department wanted to cut tree, they saw in the database that children use that forest, so they contacted that kindergarten and consulted the plans with them. Finally, some trees were cut there but a wooden bench was created for the children who could continue to visit that forest area.

The development and maintenance of the database's software requires IT programming expertise which is not available in the municipality that's why this is externalized. However, there are GIS experts in the municipality who support departments, especially the urban planning department's work by GIS analyses and maps. Beside the GIS experts, also other officers can use the database which is available through an online platform.

Different officers and leaders in the municipality have different rights to access the database which is also available for the citizens.

If new functions are introduced on the system, trainings are organized for officers to be able to use them.

On top of the software applied for maintaining the database, GIS experts apply ArcMap, Mapinfo and QGIS to implement GIS analyses producing thematic maps.

Regarding the future plans of Espoo, they would like to standardize and organise data better to make its use easier. In addition, they would like to make even more data opened for the public.

## ***Practice of of iSPACE – Salzburg, Austria***

iSPACE is a Salzburg based research organization which implement GIS analyses for public authorities. Therefore, not a GIS database maintainer company like the ones contracted by Budapest or Espoo, but a company who implement research projects for authorities.

Their job is to develop spatial indicators, implement the combination of spatial analyses in several urban development fields such as accessibility, mobility, infrastructures, green infrastructure, urban densification etc.

Most of their projects are financed from national fund, as it is not yet typical that municipalities approach them with a problem to be solved by GIS. It was identified by iSPACE as a challenge and a gap between the needs of municipalities and the solutions of GIS provided by iSPACE and similar research institutions/organizations. In the case of Espoo this GIS analytical knowledge is already available inside the municipality where GIS analyses regularly implemented according to the request of different departments. Thus, needs and solutions meet, while in most municipalities also in Budapest 12th district, this analytical knowledge is missing.

The next step could be to also contract research organizations like iSPACE who can provide scientific analyses based on the data well-maintained. By this external GIS knowledge, databases could be applied in a wider range opening new solutions for urban development and maintenance issues, and also the expensive maintenance of the database would be rewarded.

## ANNEX I. Collected information about vacant places by ALT/BAU partners

Collected information about vacant places by ALT/BAU partners			
Information	Source of data	Data format	Updates
<b>CHEMNITZ</b>			
<i>This list contains the information that the housing agency collects in its Excel database; there is more information in the different sectoral departments but these is the most relevant information for our work</i>	<i>All information generally Referencable to GIS via plot number</i>	<i>Excel Database</i>	<i>Usually more or less static info but continually updated</i>
Address	Agency/City of Chemnitz	entered individually	usually no update needed
Neighbourhood	City of Chemnitz	GIS database	usually no update needed
Focus Area	Definition by agency	entered individually	usually no update needed
Plot Number	GIS/Geoportal (state level)	GIS database	usually no update needed
Monument Status	Monument list by State government	GIS database	usually no update needed
Subject to Building Control Department's Working Group "Ruinous Buildings"	City of Chemnitz	entered individually	
Plot Size (m <sup>2</sup> )	GIS/Geoportal (state level)	GIS database	usually no update needed
Building-covered Area of the Plot (m <sup>2</sup> )	GIS/Geoportal (state level)	GIS database	usually no update needed
Number of Flats	Owner/building plans	entered individually	usually no update needed
Floor Area for residential Use (m <sup>2</sup> )	Owner/building plans	entered individually or roughly calculated (building-covered area * number of floors * 0.8)	usually no update needed
Number of commercial Units	Owner/building plans	entered individually	if necessary
Floor Area for commercial Use	Owner/building plans	entered individually	if necessary
Owner	City of Chemnitz	entered individually (e.g. land registry entry from city)	ad hoc
Owner Address	City of Chemnitz	entered individually (e.g. land registry entry from city)	ad hoc
Owner Phone and E-Mail	Owner, internet, other sources	entered individually	ad hoc
Facility Management	Owner, internet, other sources	entered individually	ad hoc

Plans of the Owner	Owner	entered individually	ad hoc
Contact Log	Continually and chronologically updated by agency from all available sources	entered individually	continually
Latest Activity	Agency	entered individually	continually
Responsible Person in the Building Control Department	City of Chemnitz	entered individually	if necessary
Responsible Person in the Preservation Department	City of Chemnitz	entered individually	if necessary
Agreement to Publication of Building	Owner	entered individually	ad hoc
Number of Floors	Site visit	Excel file or entered individually	usually no update needed
Typology	Site visit	Excel file or entered individually	usually no update needed
Year of Construction	Monument list/plans/site visit	entered individually	usually no update needed
Status of Construction/Renovation	Owner/site visit/City of Chemnitz	Excel file or entered individually	ad hoc
Need for Renovation/Modernisation	Owner/site visit/City of Chemnitz	Excel file or entered individually	ad hoc
Vacancy	Site visit	Excel file or entered individually	ad hoc
Status of left-hand neighbouring Building	Site visit	entered individually	if necessary
Status of right-hand neighbouring Building	Site visit	entered individually	if necessary
Situation of the Building Block	Site visit	entered individually	if necessary
Cardinal Direction of Street	map	entered individually	usually no update needed
Cardinal Direction of Backyard	map	entered individually	usually no update needed
Micro Context (Location)	definition by agency from maps/site visit/additional sources	entered individually	if necessary
Micro Context (Surroundings)	definition by agency from maps/site visit/additional sources	entered individually	if necessary
Potential Uses	Agency based on various sources	entered individually	usually no update needed
Demand Structure in the Focus Area	Neighbourhood analysis/Housing concept/Real estate market analysis	entered individually	if necessary
Expectable Rents	Real estate market analysis/Housing concept	entered individually	ad hoc
Costs for Renovation per m <sup>2</sup>	Experiences from comparable buildings	entered individually	ad hoc
Cluster (neighbouring Buildings in the List)	definition by agency	entered individually	ad hoc
Possible Subsidies	City of Chemnitz/Grant manager	entered individually	ad hoc

Previous Grants	City of Chemnitz/Grant manager	entered individually	ad hoc
<b>CONSTANTA</b>			
<p>administrative location;  identity of the building (some buildings have names like "Cazino" or "House with the former Emirzian house);  classification as historical monument group A historical monuments of national and universal value or group B historical monuments representative of the local cultural heritage;  buildings owned by the city hall;  how many legal status of property, restituted/ sold state;  the physical condition of the buildings;  finishing materials for the main building: facade, base, roof, cover, joinery, enclosure;  unoccupied buildings/ units, according on the payment of the habitat tax and the finding on the field visit;  building permits;  restoration works;  historical study;  functions;  height regime;  surfaces;  number of dwelling and commercial units in a building;  how many and what spaces are unoccupied, located in the basement, floor, mansard, trafficable attic;  how many garage, parking spaces;  building regime: strung, coupled or isolated;  alignment and retreats;  style;  year of construction or framing into a historical period;  historical and social information, personalities and elements associated to the history of the building;  documents and references;  artistic components inside the building;  temporary use;  owner's plans and objectives: sale, renovation, demolition, interest of owner to find buyers, users, investors, information, temporary use, etc.;  owner's proposals for the development of neighborhoods and the Peninsula area to be taken into account at the elaboration of the urban development programs and plans.</p>	<p>1. Gathering existing data from city hall departments and subordinate institutions: Urban development department, Patrimony department, General department local police, Public service of taxes and fees, Autonomous regime of public and private domain exploitation;  2. Questionnaires for property owners located in the historic center (online, emails, physical);  3. The General Local Police Department monitors buildings in the old town through site visits, taking pictures and evaluating them based on technical criteria approved by the local council.</p>	<p>Exel database</p>	<p>1. In a stage of elaborating the urban plan for the city center or other project;  2. The General Local Police Department monitors twice a year every building in the old town through site visits.</p>

<b>RYBNIK</b>			
Ownership	Land Registry, interview with owners		
Name of district	Municipality's GIS system		
Address	Municipality's GIS system		
Plot number/mark	Municipality's GIS system		
Access to the parking p lot	Site visit		
main function of the area	Site visit, internet analyses		
Distance from the main square	Google map		
Construction date (age of the building)	Interview with owners, site visit		
Building type	site visit		
Number of floors	site visit		
building area			
plot area	Municipality's GIS system		
General condition of the building	Site visit		
Present function of the building	Interview, site visit		
Function of the building described in the urban planning documents	Municipality's GIS system		
Heritage/monuments protection	Register of monument Municipality's GIS system		
General description of the building parameters not mentioned above	Site visit		
<b>SERAIGN</b>			
Location		Word file	
Size	Site visits	Excel database	according to needs and requests
Facade measurement	Talking with neighbors	GIS	

Condition of facade, roof, garden, joinery, etc. Pictures Impact on the neighborhood				
Owner name and adress old renovation permits requested possible disputes with the city	Urbanism and housing city services	Word file Excel database	according to needs and requests	
reasons for vacancy, renovation / sale / rental projects, owner's expectations	Letter and questionnaire sent to owners	Sending a postal mail Response by email, phone or online questionnaire		
<b>TURIN</b>				
size	crossing among city of torino open datas, digital cadastre, chamber of commerce records	vector (shp), databases	every semester	
usage	crossing among city of torino open datas, digital cadastre, chamber of commerce records	vector (shp), databases	every semester	
ownership	crossing among city of torino open datas, digital cadastre, chamber of commerce records	vector (shp), databases	every semester	
<b>VILAFRANCA DEL PENEDÉS</b>				
Squatted places	site visit	excel database	every year	
Usage	From owners	excel database	done once in 2015	
Usage	Web scrapping	excel database	every two years	
Property. Occupancy status. Housing characteristics	Agència de l'Habitatge de Catalunya (Housing Agency of Catalonia). Auction of real estate from foreclosures. Pre-emptive and first refusal right.	excel database	every year	

## ANNEX II. Partner specific spatial indicators for evaluating reactivation potential and need of vacant places

CHEMNITZ		
General Criteria	Spatial Indicators	Values
Structural condition / degree of rehabilitation need	Time of the last renovation	2 - renovated (up to date) 3 - renovated (used, usually 1990s) 4 - dilapidated (not renovated since 1990) 5 - ruinous (severe structural decay)
Urban / neighbourhood significance	Inside historic residential inner-city neighbourhoods	5 - locates inside the border of the specific city area 4 to 1- locates in ...distance from the border of the specific city area
	Inside delimited redevelopment areas (priority, options for renovation grants);	
	Other special needs areas (e.g. main access roads with high traffic loads) or with socially complex situations;	5 - districts/ having the highest rate of listed buildings 4 to 1 districts/ having the ....rate of listed buildings
	Inside areas with high number of listed buildings (monument status)	
Heritage value	Listed buildings or buildings with heritage value	5 - Listed heritage 4 to 2- Not listed but having high heritage value (only the gardens or the interior are protected; or part of a larger monument complex) 1 - not having heritage value
Size of the building	Residential buildings having 4-5 floors, 8-16 flats, 500-1500 m <sup>2</sup>	5 - Residential buildings having 4-5 floors, 8-16 flats, 500-1500 m <sup>2</sup> 1 - Buildings having other sizes
Area located	Areas with low noise pollution/Areas located not close to roads having high traffic Areas locate close to public transportation, cycling roads Close to parks Close to the inner city	1 to 5 according to noise pollution categories/1 to 5 Locates ... distance from roads having high traffic 1 to 5 locates ...m distance from bus stops/cycling path/parks

		Inside the inner city or inside ...m distance from inner city border
Duration of vacancy	Long-term vacancy of the whole building Short-term vacancy of single flats	1 to 5 according to time categories, short time gives 5 at flats, while long time gives 5 for whole buildings
Interest of private investor / owner	Difficult to formalise. We have developed an "owner typology" (e.g. speculators, professional developers, overwhelmed heirs,...) which could be roughly formalised and added to the list; there is also a kind of "investor" typology who search for different kinds of buildings (e.g. professional developers search for monument buildings because of the possible tax exemptions - in this case the building condition is less important, local Chemnitzer's prefer specific neighbourhoods in good building conditions, Co-housing initiatives may search in inner city neighbourhoods close to public transport for rather cheap buildings); thus there different main parameters that we find as determining for the interest of private investors/buyers	
Developing opportunities	Future use/function of the building	5 - fully residential or mixed residential/commercial (e.g. shops in the ground floor); 3 - commercial or public uses 1 - other function
CONSTANTA		
Criteria	Spatial Indicators	Values
Structural condition / degree of rehabilitation need	Need for emergency intervention	5 - emergency intervention 1 - no need for emergency intervention
Urban / neighbourhood significance	Locates inside the historical city centre	5 - locates inside the border of the historical city centre 4 to 1- locates in ...distance from the border of the historical city centre
Heritage value	Historical monuments or buildings having architectural or ambiental	5 - historical monuments 4 to 2- not monuments but having high heritage value 1 - not having heritage value
Size of the building	Not relevant	
Area located	Locate in residential and touristic area	5 - inside residential and touristic area 1 - not inside residential and touristic area
Duration of vacancy	Time categories - the price of rehabilitation increase with time degradation	5 value applied for longer vacancy as the need for rehabilitation is urgent, however the

		potential for reactivation is lower for longer vacancy. Contradictory indicator if we analyse reactivation need and potential in the same time.
Interest of private investor / owner	No information available about interest of investors	
Developing opportunities	Locate in areas where public spaces and infrastructure recently rehabilitated	5 – Inside the area recently rehabilitated/...m distance from the street recently renovated/having the address of the street recently renovated 1 – not in recently renovated area/street
RYBNIK		
Criteria	Spatial Indicators	Values
Structural condition / degree of rehabilitation need	Technical condition of the construction elements Access to the media (ex.: heat, gas)	According to the data collected about the building's parameter
Urban / neighbourhood significance	Locates inside the city centre	5 – locates inside the border of the city centre 4 to 1 – locates in ...distance from the border of the city centre
Heritage value	Not particularly relevant Listed heritage	5 – Listed heritage 1 – Not listed heritage
Size of the building	Not relevant	
Area located	Locates inside residential area Distance from the main square	5 – inside residential area/ ... m distance from the main square 1 – not inside residential area/... m distance from the main square
Duration of vacancy	Not particularly relevant	
Interest of private investor / owner	Number of potential buyers, also city departments and other stakeholders who contacted the owner in the last year	5 – high number of buyers, 4 to 1 lower number of buyers in the last year
Developing opportunities	Present function of the building Function of the building described in the urban planning documents	
Ownership	Number of co-owners Law/ownership situation	5 – one owner; clear ownership situation 1 – more owner; difficult ownership situation
SERAING		
Criteria	Spatial Indicators	Values

Structural condition / degree of rehabilitation need	Condition of buildings: 4 categories, from A, worst condition, to D, best condition (The best would be to reactivate first the A or B categories, that have a bad impact on neighbourhoods, but they are the hardest and most expensive cases. So decided to focus first on C or D categories which are easier cases for easier results and then to get to tougher A and B cases)	1 - A and B categories having a bad impact on neighbourhoods, but hardest, most expensive ones, low reactivation potential but more need 5 - C and D easier cases, higher reactivation potential but less need
Urban / neighbourhood significance	Inside the priority intervention zone called the industrial valley Inside the selected 3 neighbourhoods  Locate in selected streets impacted the most by the industrial crisis	5 - Locate inside the border of the zone/3 selected neighbourhood/locate in the specific streets selected 1 - not locate inside the border of the zone/3 selected neighbourhood/not locate in the specific streets selected
Heritage value	Not particularly relevant, rather: Visibility/impact on neighbourhood: Locate on square Corner building	5 - having a square address/corner building 1 - not having a square address/not corner building
Size of the building	Bigger family houses more attractive for investors to create apartments Occupied houses with vacant commercial ground floor	5 - Bigger family houses having high reactivation potential(big should be specified more concretely)/ having vacant commercial ground floor 1 - not big enough for creating apartments/ no vacant commercial ground floor
Area located	Locate in recently renovated neighbourhoods	5 - Inside the area recently renovated 1 - not in recently renovated area
Duration of vacancy	Time categories - the price of rehabilitation increase with time degradation	5 value applied for longer vacancy as the need for rehabilitation is urgent, however the potential for reactivation is lower for longer vacancy. Contradictory indicator if we analyse reactivation need and potential in the same time.
Interest of private investor / owner	Image of the area where vacant places locate - These districts have a bad reputation, and the interest of private investors is therefore still limited	
Developing opportunities	These neighbourhoods have a bad image in the rest of the city as well in other cities. however, these districts are already or will be the object of renovations and transformations which will greatly improve the quality of life for inhabitants. today you can find pretty houses there at cheaper prices than elsewhere, which is a great opportunity for some people to become owners. So, we need to communicate and highlight these opportunities	

TURIN		
Criteria	Spatial Indicators	Values
Structural condition / degree of rehabilitation need	Energetic condition of residential buildings built from the 1950s until the 1970s for the families of FIAT workers.	5 to 1 - level of energetic condition
Urban / neighbourhood significance	a) In case of former industrial buildings: neighborhoods/areas presenting good accessibility features (connection with city centre and main infrastructures: railway stations, metro stops, highways) and proximity to the hotspots such as universities, city centre, production clusters; b) in case of vacant flats/commercial spaces into buildings: districts already under regeneration processes, closeness to universities.	a) 1 to 5 -locate ... m distance from railway stations, metro stops, highways, and hotspots b) 5 - locate in ..m distance zone of the university/locate inside the border of an area under regeneration process 4 -1 locate in further distance from the university 1 - not locate inside the border of an area under regeneration process
Heritage value	Listed heritage	5 - Listed heritage 1 - Not listed heritage
Size of the building	Industrial buildings: depends on the programme investors have Flats: small-medium size flats	Flats: 5 - small-medium size flats 1 - bigger flats
Area located	Locates inside residential area	5 - inside residential area 1 - not inside residential area
Duration of vacancy	As in Torino we don't have clusters of vacant buildings, time actually doesn't affect the reactivation potential. It is more a matter of context (composition & population of the interested area), accessibility, stakeholders' networking.	
Interest of private investor / owner	Number of potential buyers per month	5 - at least one potential buyer per month 1 - less than one potential buyer per month
Developing opportunities	Current opportunities linked to residences for students, residences for elderly people	5 - having opportunities 1 - not having opportunities should be more specified
Availability of public spaces	Public spaces in close	5 - in ...m distance zone of the public spaces of the city 1 - out of the zones or in further zones
VILAFRANCA DEL PENEDES		
Criteria	Spatial Indicators	Values

Structural condition / degree of rehabilitation need	Degree of rehabilitation need Having elevator	5 - no need 3 - moderated need 1 - strong need
Urban / neighbourhood significance	Locates inside the downtown/historic centre	5 - locates inside the border of the downtown/historic centre 4 to 1- locates in ...distance from the border of the downtown/historic centre
Heritage value	Listed heritage	5 - Listed heritage 1 - Not listed heritage
Size of the building	Large buildings having priority	5 - large buildings (concrete size to be specified) 4 to 1 - medium and small buildings
Area located	Locates inside residential or commercial area Located in deprived neighbourhoods	5 - inside residential area/commercial area/ deprived area 1 - not inside residential area/ commercial area/ area having social needs/ deprived area
Duration of vacancy	Time categories - the price of rehabilitation increase with time degradation	5 value applied for longer vacancy as the need for rehabilitation is urgent, however the potential for reactivation is lower for longer vacancy. Contradictory indicator if we analyse reactivation need and potential in the same time.
Interest of private investor / owner	Investor interest is low at the moment, but we intend to make it grow with the entry of investors specialized into these types of refurbishment, who work with cooperative funds.	
Developing opportunities	The Covid-19 crisis has made us see some of the shortcomings of our building stock, which in some cases are insurmountable. In buildings (or in their areas ) must also be prepared to introduce a new model of relationships in which work must be present.	