

## Defining Economic Typologies based on an Economic Activities Database

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### 1 ABSTRACT

Economy and especially economic activities play a fundamental role in cities and in surrounding areas: it keeps the city functioning, in terms of jobs, goods and services. Considering this fundamental role of economy and economic activities and the vast amount of space it uses, it should be deeply studied and understood in order to guarantee a solid future to the sector itself and the cities.

This paper represents an attempt to research more in depth this matter: it tries to show how economy is organised and structured in a city and surrounding areas and how it can be analysed and considered by policy makers. The aim is to define economic types that represent the frame on which different types of spatial policies, ideally one for each economic location type, should be developed and implemented by policy makers.

The project is based on a visual economic activities database. This contains information on all the visible economic units where people work or that are meant to be worked in. The study areas are the northern part of Brussels and two other areas located in Flanders (Belgium). Thanks to this visual inventory, we first tried to define a GIS methodology that defines and subdivides the economic fabric into different areas, according to the concentration of economic activities. This work is based on the hypothesis that the morphology of parcels with economic units on them is an indicator of location choice of companies. Secondly, we combined the database of economic activities with the data on economic fabric concentration in order to define and analyse different economic location types which represent potential economic locations for companies.

In this paper we will explain the method used for the data elaboration and the difficulties encountered during the work. We will also discuss how this new economic location types could be used as an instrument in a planning or policy process to define the future perspective for a specific area.

Keywords: GIS, economy, spatial policies, mapping, economic types

### 2 INTRODUCTION

In the research project „Segmentatie van werklocaties in Vlaanderen“ (van Dinteren, Muskens, Geudens, & HaskoningDHV, 2015) the conceptual framework looks for product-market-combinations in spatial economic planning. The basic idea is to link a group of companies to a specific location, because the area provides them with the necessary amenities. In economic site location theory, the location would then have homogenous conditions such as real estate price, transport cost, labor cost, agglomeration effect, monopoly and access to international trade (Cabus & Saey, 1997; Friedrich, 1929; Van Meeteren et al. 2013).

From the perspective of spatial planning practitioner, a vast number of economic activities seems randomly placed, regardless their location in dense urban areas, suburbs or the countryside. However, when looking at the mapping of economic activities, some of the locations might have a direct link to Walter Christaller's Central Places theory (Christaller, 1933), eg the marketing principle may be observed in shopping streets, the transportation principle around metro stations, and the administration principle in the location of hospitals. Moreover, we can use other parts of economic site location theory to give us some more insights (Cabus & Saey, 1997; Van Meeteren et al., 2013), but this is only possible if the available data on economic location/activity is accurate (Gruijthuijsen et al., 2018).

In this paper we will present a first attempt of dividing a real territory into different types of existing economic fabric. We will use three sample areas: the Brussels Northern Area, Hasselt and Koksijde-Veurne, because they represent the extent of the variation in the Belgian Northern economic territory. From the result we will discuss if we can observe a correlation between the companies present in a certain area and their

assumed motivation, based on theory, to choose this site. The motivation can also be captured in interviews, which are not described in this paper, but are part of the overall research-trajectory.

In a next step, we can experiment with the types in current spatial planning processes. The visualization of the diversity of types and the scales of economic activities, combined with the subsequent analysis can be considered as a set of information that can be used in a urban development and economic policy making process. We believe that this new information about economy we provide through this project represents a concrete tool that politicians, policy makers and planners could use in order to fill the knowledge gap about the city economy that they are facing nowadays. Spatial practitioners find specific functions and activities fundamental to keep the city functioning. Ferm and Jones mention: to provide goods and services to its businesses and residents, to deal with its waste, to provide materials for its construction, and so on (Ferm & Jones, 2016). In the last decades many European cities, (eg London, Copenhagen, Antwerp,...) have set up policies and processes aimed to deindustrialize, while encouraging a rapid growth of services, knowledge economy and housing. Many industrial and logistic activities however are necessary to keep an office building functioning. Activities related to catering, cleaning, furniture, maintenance and fit out, office equipment and supplies, print and copy, security, waste disposal and more are consequently located away from the central areas, often clustered in the suburbs or even further out in the countryside (Ferm & Jones, 2016). Despite this, those activities are vital to the efficient functioning of the city and in supporting its global role (Harris, 2013).

In addition to the results of first phase (Fig.1), where the creation of an economic activities database and its first analysis form a solid base for the future development of the project (Giaretta & Zaman, 2017), we expanded the mapping to a contiguous territory in the Brussels Northern Area. Additionally BCI and the Katholieke Universiteit of Leuven in collaboration with Departement Omgeving of the Flemish government worked on a related research project (Gruijthuijsen et al., 2017). The project aimed to extend the economic activities mapping while adding new areas in Flanders (5 study areas in different regions), and at the same time it improved the methodology and the successive data analysis. The project studied more in detail how companies are distributed and mixed together.

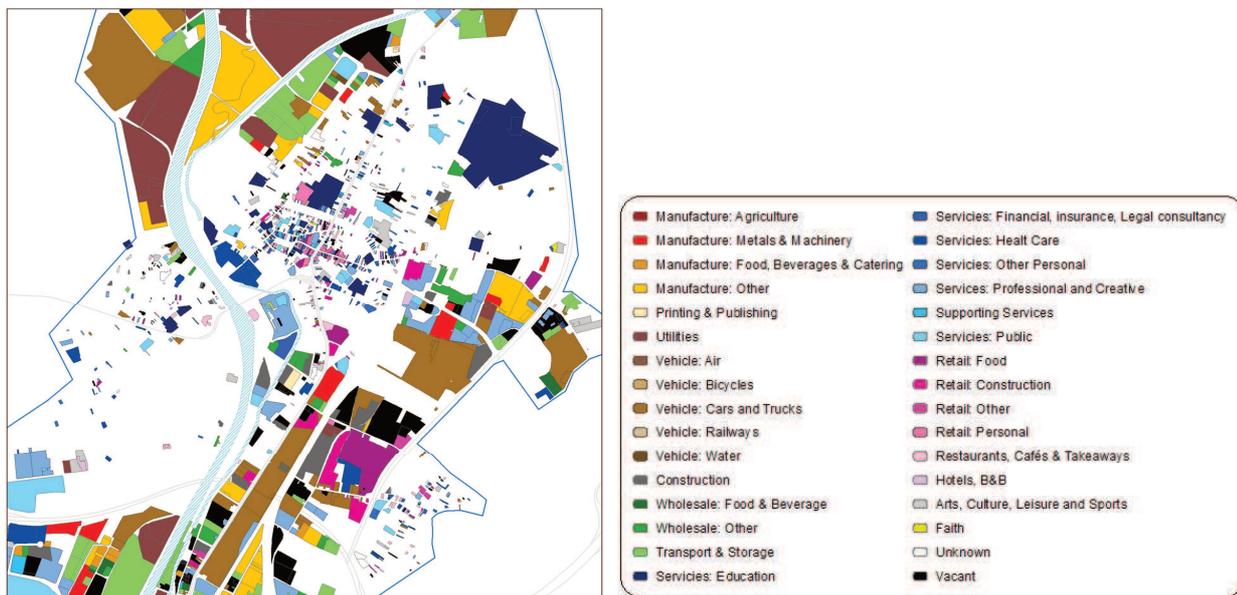


Fig.1 Dominant economic use map and categories (Giaretta & Zaman, 2017)

BCI and KULeuven take cityshape and city-parts as a starting point for the search for new typology of economic locations (the perspective of the spatial practitioner first). They set of with this first definition of economic location types, that were discussed in two workshops focussing on defining economic types. This proved that is possible to define economic types based on an economic activities map and, in addition of this that policy makers and planners can discuss and work together on this topic (Gruijthuijsen et al, 2018).

In this paper we show the approach we followed for the economic location types definition. In this research, we do not take the parts of the shape of the city as a starting point: we first look at the economic activities in space and their spatial relations. Afterwards we combine them with other spatial information about

neighbourhoods. The research question was if this method results in another typology of economic locations than the BCI/KULeuven typology.

We decided to use only the data contained in the two economic activities database created by us and KU Leuven, processed in GIS using Arcmap software. The data we used are: parcels identification numbers (Capakey), economic units activity codes and the dominant economic use of the each parcel. All the other data contained in the databases like presence of housing, number of buildings and storeys on a parcels and other non dominant economic uses were not considered.

### 3 PROXIMITY BETWEEN ECONOMIC ACTIVITIES AS A BASIC CONCEPT

To define the typology of economic areas we use a four-step approach. The construction of the typology of economic areas is an analysis and interpretation based on Waldo Tobler's first law of geography „everything is related to everything else, but near things are more related than distant things“ (Tobler, 1970). The aim is to define clusters of similar activities or similar mix of activities, with a specific proximity. Proximity represents a good indicator of how companies work on the field, and why they are located in a specific area. As mentioned proximity can be considered as one important factor in a company location choice because of the presence of:

- a shared infrastructure that is used by all the companies in that specific area,
- an agglomeration effect, where companies share the same clients or use similar spaces, e.g ground floors in a shopping streets,
- spatial policies or regulation effects that in some cases can justify the presence of multiple companies on the same site, such as office parks, port areas, industrial zones, etc.,
- a spatial monopoly, eg retail companies in the vicinity of IKEA.

The first step is to run the ‚NEAR‘ tool in ArcGIS and to calculate the distance from each parcel with economic activities to the nearest. The results are represented in three categories: (1) the parcels that are adjacent, (2) the parcels that are close to the next parcel where proximity might be significant, and (3) parcels that are far away from the next where an relation to the next company is not likely to be caused by proximity. The threshold between the second and third category is based on a visual comparison between three calculations: the upper decile, upper quintile and  $MEAN+1,92*STDEV$ . This empirical method to choose the threshold seems the most appropriate one, as the distribution of the data is not normal, indeed very skew, often with a long or fat tail (Fig.2).

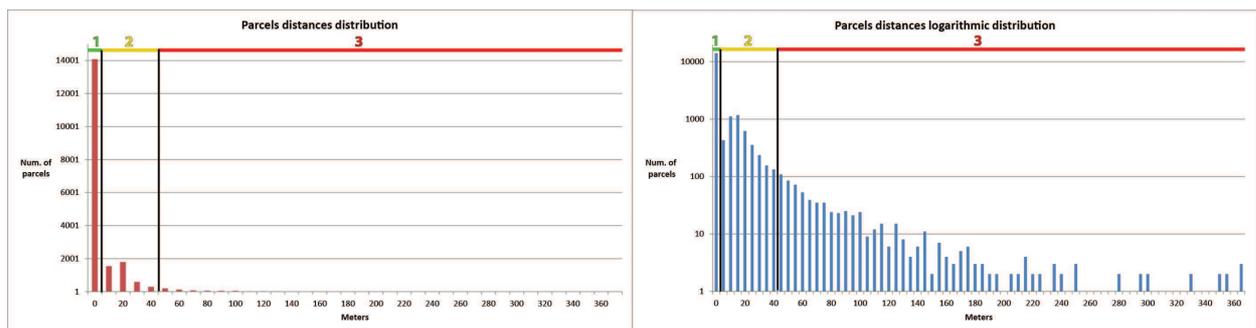


Fig.2: Data distribution for Brussels case study area (frequency table)

The second step takes the sensitivity of the data to the proximity calculation in account. Some companies use two parcels, but are no part of a continuous fabric of adjacent activities. From the first category, we select the parcels that might be wrongly classified as ‚adjacent to other activities‘.

In the third step we interpret the categorisation of parcels with economic activities by manually subdividing the study area in three morphological zones: areas with (1) continuous economic fabric, (2) areas with discontinuous economic fabric and (3) areas with dispersed economic activities. The specific tools used and problems faced to create this morphology are described in chapter 4.

From this morphology, we further subdivide the areas based on the presence of specific economic activities in the fourth step. This subdivision is the first version of the typology of economic locations, further elaborated in chapter 5.

The complete four step approach uses the dominant economic use for each parcel contained in the economic activities database we created in the first phase of the project. The information about the use of space enables us to subdivide the three morphologies in a total of twenty-two different economic location types. The falsification of this subdivision in 22 types will be part of the third phase of our research. We will use the typology in current spatial planning processes, and evaluate the assumption that the types correspond to specific product-market-combinations. Next to the pragmatic test, we will further analyse the distribution of activities in each of the categories, and reveal the sensitivity of the subdivision in types.

#### 4 MORPHOLOGY, IN SEARCH OF OBJECTIVATION

In this chapter we present the morphology analysis we carried out. We first explain why the study of the economic morphology in a specific area can help to explain how companies are spread and organized, then the GIS procedure we followed and the results we obtained.

With the term economic morphology, we consider the distribution of economic functions related to a specific context. Economic functions are defined by all the cadastral parcels with at least one economic unit on it. These parcels and their uses were obtained from the visual economic activities database Departement Omgeving and BCI/KULeuven developed. The study of economic morphology is important in order to define an area from an economic point of view. The aim of this phase was to subdivided the economic fabric in different zones, based on the continuity of the fabric itself. The continuity or discontinuity is a clear indicator about the presence of different economic dynamics defined by companies located in each area.

As mentioned, morphology classification was carried out while combining a first GIS analysis phase followed by an interpretation of the results. At first we tried to define the different classes only using an automated GIS procedure that could have been afterwards replicated in different case study areas leading to similar results. Soon we realised that this was not possible. To simplify the procedure, a phase of interpretation was introduced to get a reasonable result in terms of morphologies definition for each sample.

Starting from the cadastral map shapefiles we filtered out all the parcels without an economic use in it. In order to select just the parcel with an economic use we made a "join" between the cadastral map shapefile and the dominant economic use table created in the conomic activities database, based on parcels identification number (Capakey). In the Brussels case study we then merged the two filtered cadastral shapefile (Brussels and Flanders ones) into a single one and exported it as a new shapefile. This last step was necessary in order to run the "near" tool, this function determines the distance from each feature in the input features to the nearest features in the near features. We used this tool in order to determine the nearest distance between parcels (Features), that in our project represent the indicator on which proximity is based. A new field with nearest distance between parcels was then added to the attribute table and used for results analysis (Fig. 3)

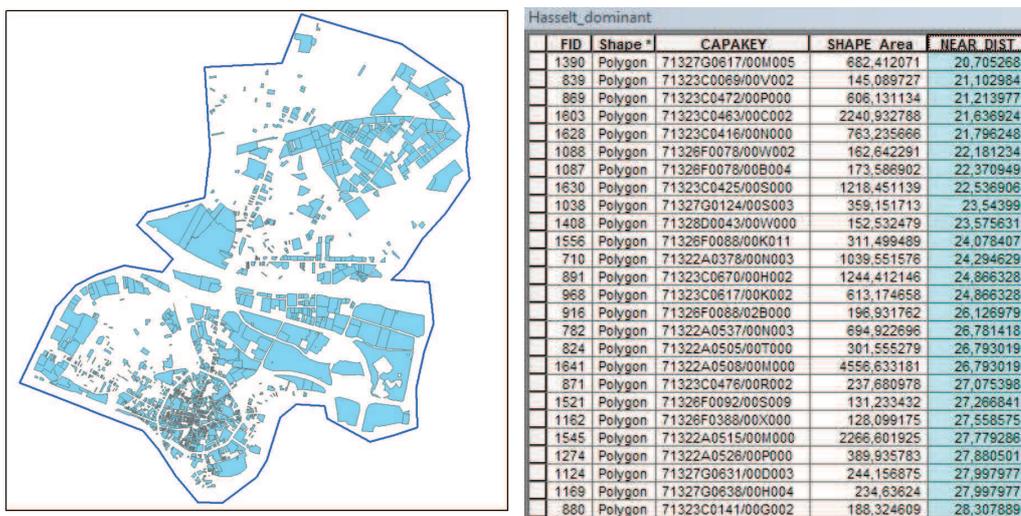


Fig.3: Economic parcels and near distance table (Hasselt case)

From the "near" table, we started the results analysis in order to define different types of economic morphologies based on distances between parcels. Three different categories plus a fourth one, and their

related shapefiles were defined: Continuous economic fabric, discontinuous economic fabric, disperse economic fabric and ad as last undefined economic fabric (Fig. 4a).

Each category is defined as follow: “Continuous economic” fabric indicate all the parcels located next to each other, in which the distance to the closest one is zero and is represented with a green colour, “discontinius economic fabric” is defined as parcels where near distance is between zero and the threshold one explained in chapter 3 and is represented using a yellow colour, remaining parcels with a near distance bigger than the threshold one are part of the “disperse economic fabric” category and is represented using a red colour. The last category, the „adjacent to other activities“, needs a specific explanation. During the analysis of distances we saw that isolated companies, who are on more than one parcel located one next to each other, were defined by GIS “near” tool as part of the continuous economic fabric. This do not represent what really happens on the field, companies located in a open space or in a low density area are not comparable from a location point of view with the ones located in a continuous economic fabric even if they appear in the same category. In order to filter out the described parcels we first used the GIS “dissolve” tool on the continuous economic fabric shape, that creates a new coverage by merging adjacent polygons that have the same value for a specified item, and then we recalculated the near distance. We then selected and exported into a new shapefile the undefined parcels. These parcels can belong to any of the three categories. Those parcels are the ones where the near distance is bigger than the data population mean and with an area smaller than 5400m<sup>2</sup> (based on empirical observation as described in chapter 3).



Fig. 4a Morphology at parcel level and Fig. 4b. Morphology at area level

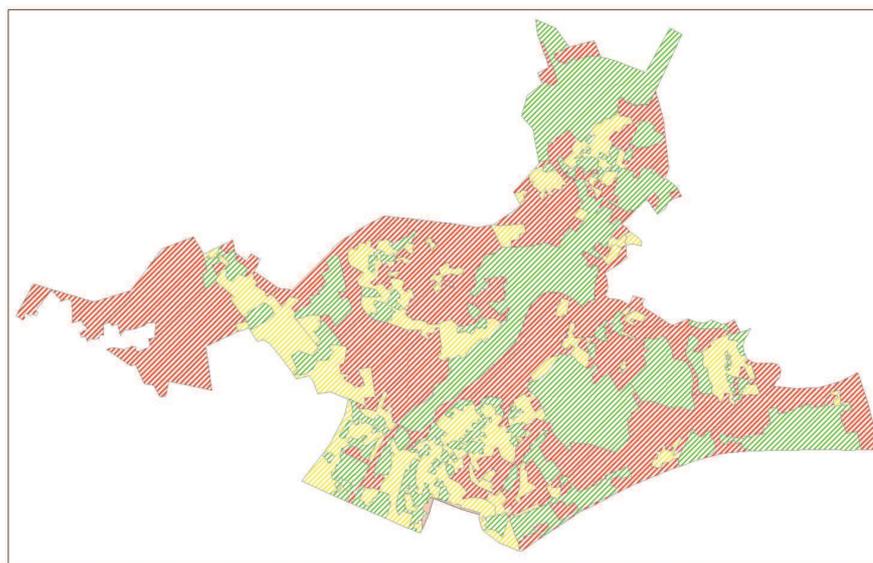


Fig 5a: Morphology for Brussels Northern area

As a final step of this phase, we interpreted the GIS analysis result. This consisted in transforming the three above-mentioned categories from a set of polygons made out of parcels (Fig. 4a), in morphologic areas able to cover the entire surface of each case study area (Fig. 4b). In order to do that we edited the areas in shapefiles while splitting those into polygon and then coding them according to the morphologies definitions. As a result we obtained a subdivision of the areas in polygons able to represent the different morphologies, as shown in Fig. 5a-c.

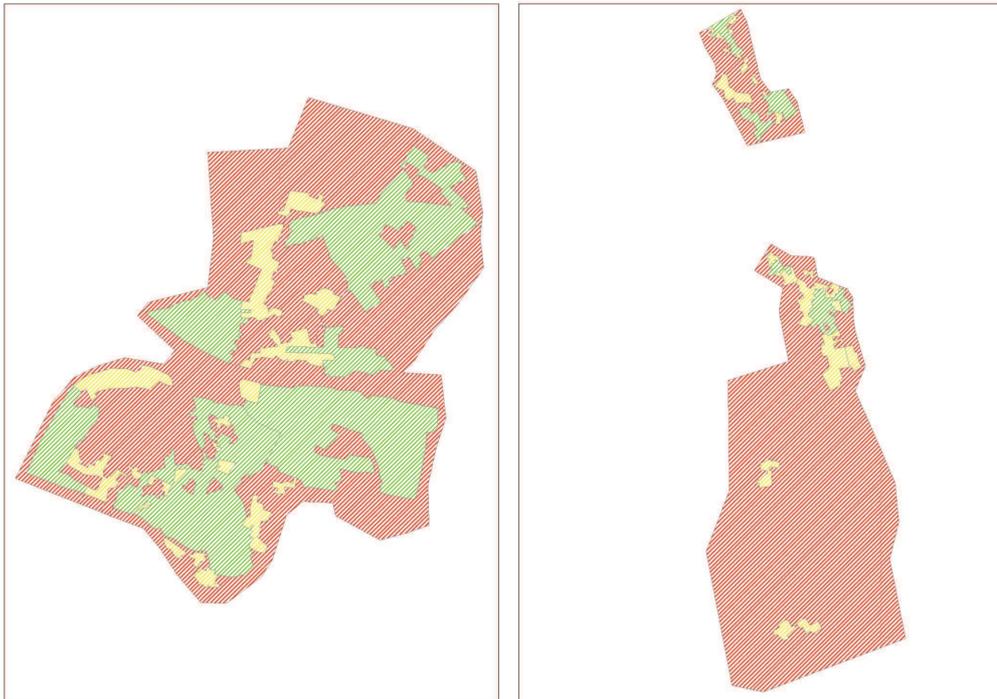


Fig. 5b Morphology for Hasselt and Fig.5c Morphology for Koksijde-Veurne

## 5 TYPOLOGIES

In this chapter, we present the economic location types we defined in our project. The types of observed (or potential) economic locations for companies are defined as areas located in the same morphological zone, as explained in chapter 4, that are characterized by the same economic fabric continuity and by the predominant presence of an economic use, or a combination of uses.

The definition of types is based on an analysis of the three typologies of economic morphology, that were presented in the previous chapter, combined with the dominant economic use map derived from our economic activities database. This phase is based on a visual interpretation of the two combined layers, aimed to identify first the presence of patterns in the economic structure and then, secondly, clusters of activities inside those patterns. In doing so, we were able to define different economic location types.

Starting from the three main morphological groups, a total of 22 different economic location types were defined. The first two groups represent the “Continuous economic fabric” and the “Discontinuous economic fabric” areas and are splitted in a total of 7 categories each, based on activities codes and their distribution. The third group represents the “Disperse economic fabric” subdivided in a total of 8 categories. The main difference between the first two groups and the last one is based on the data we considered for types definition. In the first two cases, the combination of the economic dominant use and morphology layers gave an adequate amount of information to develop the economic location types. From this combination we derived mainly economic patterns and activities clusters inside a morphological area. Examples of clusters we identified are areas where retail, restaurants and bars represent the main activities and there are almost no other economic uses (11 and 21); same for areas characterized by the only presence of service related activities (12 and 22). Another example of monofunctional type is identified by the portion of economic fabric where activities are related just to art, culture and sport and are not isolated (13 and 23). Combination of manufacture, wholesale, transport companies and car related activities in a same area easily define an industrial cluster (14 and 24). Big and isolated activities clusters are represented by hospitals, sport facilities, shopping centers or other activities that usually take a large amount of space and present different sizes and

uses if compared with surroundings (17 and 27). Areas where retail and services co-exist together without one prevailing over the other are identified as mixed retail/services areas (15 and 25). In some cases activities related to industry (manufacture, wholesaler, car dealers and repairers, etc.) are also part of a services and retail mixed area, for this reason a different mixed type was defined (16 and 26). Figure number 6b-d show the results in terms of economic location types for the first two groups, based on the observation and interpretation of the mentioned data layers combination.

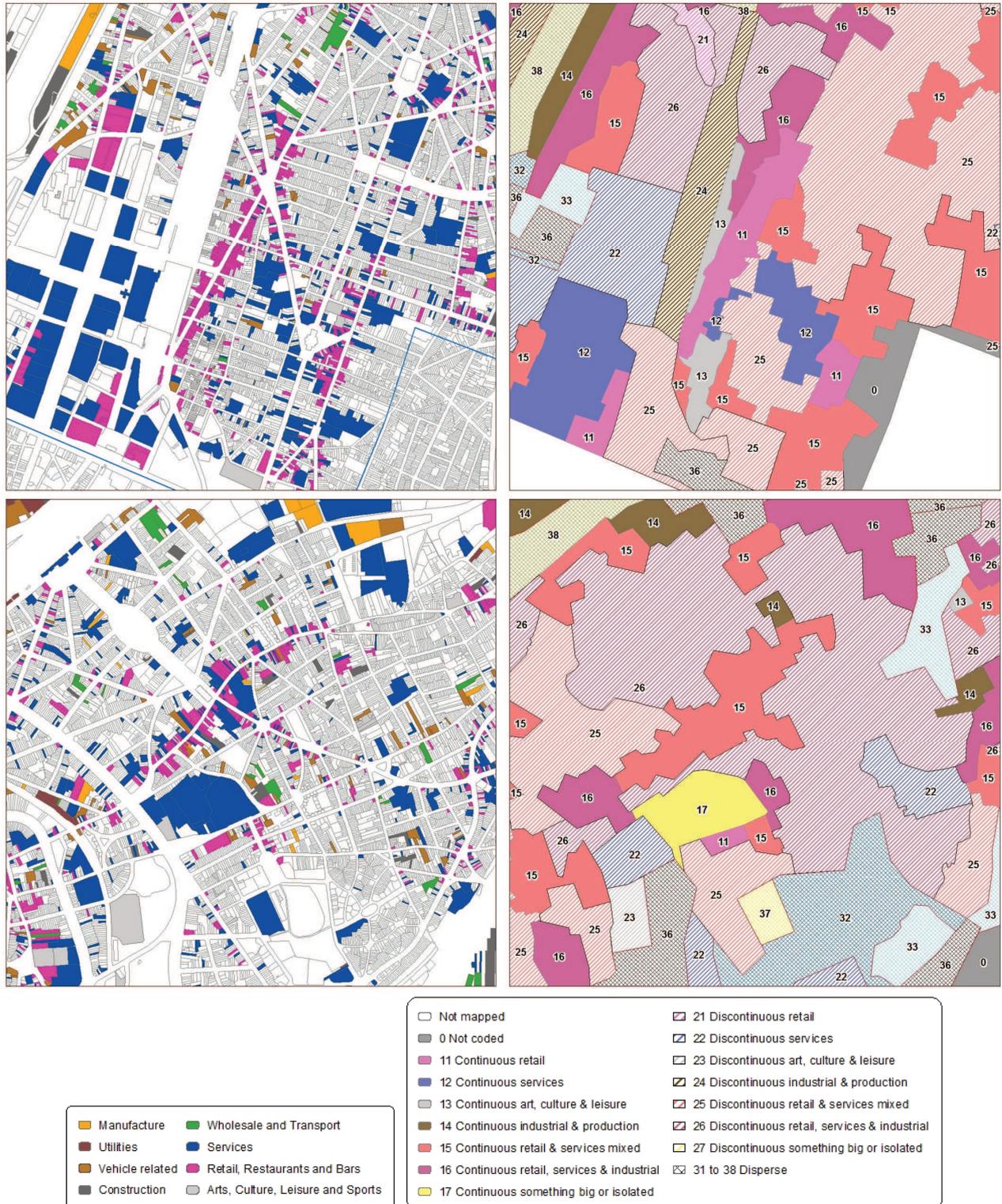


Fig. 6a (top left): Dominant economic use ,North Station', Fig. 6b (top right): Economic location types ,North Station', Fig. 6c (bottom left): Dominant economic use ,Helmet', Fig. 6d (bottom right): Economic location types ,Helmet'

In the last group, the dispersed one, we realised that the information contained in the mentioned data layers, combined with longer distances between economic activities, were not enough to identify patterns and define

economic location types based on a simple observation. For this reason other data were necessary. Despite this, external data sources were not used. The complementary data we used were already contained in our database, and consisted of the cadastral map parcels and buildings. Thanks to this, we were able to identify building clusters, isolated buildings, empty and open space areas, which consist of a fundamental set of informations for the types definitions in a disperse environment. Six different categories were defined (Tab 1.), based on the presence of: bulding clusters, economic activities and parcels. Two other categories complete this group, “big and isolated activities” and “farms”. These two represent exceptions because in comparison with the other categories, they show different dynamics in relationship with surroundings areas and activity regulations.

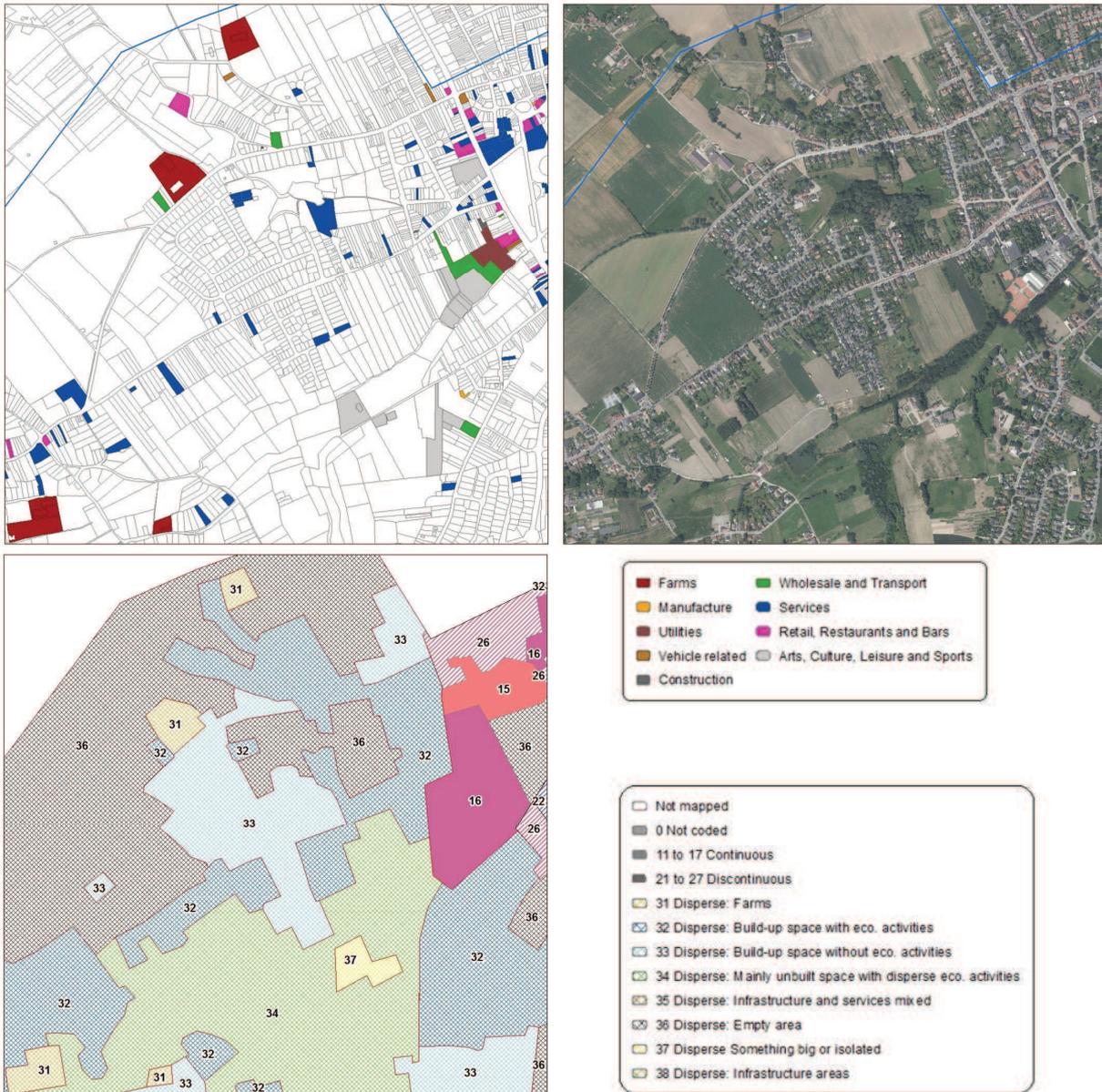


Fig. 7a: Dominant economic use, Fig. 7b: Area orthophoto, Fig. 7c: Economic location types

Category	Building cluster	Economic activities	Parcels
Build-up space with economic activities	✓	✓	✓
Build-up space without economic activities	✓	✗	✓
Mainly unbuilt space with disperse economic activities	✗	✓	✓
Infrastructure and services mixed	✗	✓	✗
Infrastructure areas	✗	✗	✗
Empty areas	✗	✗	✓

Tab. 1: Disperse categories definition

For the attribution of the economic location type code, we first splitted the economic morphology polygons in an editing sessions using GIS. Then we created a new field in the attribute table and finally recoded each new polygon using the respective economic type code.

## 6 DISCUSSION

In search for knowledge about the location of economic activities, the Departement Omgeving of the Flemish government started with mapping of activities. In this paper we proposed an attempt to define different types of economic fabric. We believe that these types should be useful for spacial economic policy making in the future.

The combination of the expanded Brussels Northern area mapping and the mapping in the Flemish study-areas (BCI/KULeuven) in different territories was fundamental for types definitions. Among others the differentiation in urban form (metropolitan, suburban, local centre, coastal), density and transportation infrastructures is broad in the sample. The results of the mapping show a broad differentiation in presence and patterns of economic activities but also a repetition of patterns in the different study-areas.

Referring to Tobler's first law we used distances between economic activities as a starting point for division of the mapped territory, applying the near function in GIS. This application supports the researcher to objectivate drawing lines between the areas packed with economic activities and those with less, in order to get away from pre-conceived ideas of urban structures. Adding variation of activity types makes it possible to define economic location types.

So, a location type can be described using two characteristics: proximity and variation in combination of activities. The continuous and discontinuous economic fabric areas can each be divided in the same types considering the combination of activities. To define types in the dispersed economic fabric area, supplementary information is added. Types in dispersed economic fabric area are defined referring to agrarian economic activity and non-economic function(s) of the area.

Especially in the continuous economic fabric area, the map shows us location types that look familiar for the spatial practitioner: predominant retail in shopping streets, predominant services in CBD, industrial area etc, defining them is rather easy. On the other hand, some of the types prevail on locations we would not expect or they appear in another spatial pattern. Examples of this are the services areas (12) close to shopping streets (11) or a small retail and services area (15) close to a metro station. The mark of the areas in the discontinuous areas is more submissive to coincidence and interpretation, what makes the exact area demarcation more unsure. Especially the knowledge of this areas is fundamental for a future policy on mixed use. Further research will be conducted on this kind of areas, including the extent of mapping.

The more precise the marking of locations, the more it becomes possible to describe the location types quantitatively, for example with the mesures used in the study (BCI) (Gruijthuijsen et al., 2017) or distribution of activities among types.

This dataset and spatial typology give extra opportunities to combine the results with other data. As stated in (Gruijthuijsen et al., 2018) some location types can be enriched by other data. Further research will make it possible to know which of the types can be located without the intensive mapping, using existing data. The prevalence of different types can also be combined with maps defining settlement and urban structure (resulting from on-going research).

The research shows that, starting from the mapping of economic activities, we are able to define a typology of economic activities. As we base our research on Tobler's first law, we assume that there is a possible relation between companies. This relation could be limited to one or more site location choice factors. In the continuous economic fabric we can propose the following relations:

- A shopping area (11) has a shared market, similar real estate prices, and an agglomeration effect
- A mixed shopping and services area (15) has a shared market, similar real estate prices, and an agglomeration effect
- A industrial area (14) has a specific set of regulations, a shared infrastructure, similar real estate prices and a shared accessibility
- A services area (12) has a specific set of regulations and similar real estate prices

- Something big (17) has its own rules and history

Similarly, we can think of shared motivations between companies in other areas. For dispersed and discontinuous areas this is however more difficult to do.

Between different areas in the same type, there will be big differences (eg real estate price or transport cost), but we state that companies find the same set of location factors decisive.

Overviewing the whole we are convinced that the differences between types gives already a useful set of information for policy preparation. The aim is to define economic types that represent the frame on which different types of spatial policies, ideally one for each economic location type, should be developed and implemented by policies makers.

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