

# Extension of the Road Network as the Determinant of Development of the Regions on the Example of Cracow (Poland)

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**Abstract.** The construction and development of the road network determines the economic level of the region and the country. The aim of the publication is to show the relationship between extension of the road network and the development of the warehouse and industrial areas located in the city and the Krakow region. The methodology of research works consisted in the use of data contained in local spatial information systems for the analysis of land development. The research was carried out at the Rybitwy area. It is an area located in the south - eastern part of Krakow. This area is considered to be the logistic center of Krakow and has been analyzed in the aspect of the impact of the construction of the eastern bypass of the city, on the development of facilities with a warehouse and industrial function. The eastern bypass of Krakow is located along the S7 expressway connecting southern Poland (Zakopane) with its northern end (Gdansk). The conducted research proved that over the period of the investment (2010-2018), more than 19,000 m<sup>2</sup> of warehouse and production space were built in the area of Rybitwy. The increase in interest in the analyzed area is also confirmed by a significant increase in the degree of lease in this area. Before the construction of the bypass, the vacancy rate was equal 30% of the area intended for rent, while on the date of analysis (2018) already only 10%. This shows the development of the studied area and its attractiveness for entrepreneurs. In addition, the development of the road infrastructure in the form of the eastern bypass of the city of Krakow (along the S7 route) has contributed to the creation of a special economic zone in the area of the Wieliczka commune. This commune is adjacent to Krakow. The Wieliczka Economic Activity Zone, due to its location in the vicinity of the Krakow agglomeration and direct access to the S7 expressway, encourages entrepreneurs to locate their businesses in this area. At the date of the analysis over 30,000 m<sup>2</sup> of warehouse and production space were built there. Therefore, the development of the road infrastructure is an important factor determining the location of industrial or warehouse facilities, which contributes to the economic development of the region, as well as to the increase of the competitiveness of the Polish economy.

## 1. Introduction

Optimal use of natural and acquired features of investment areas constitutes the overall activity aimed at the rational space development taking into account current and future needs of society. Proper investment decisions enable successive implementation of the principles of sustainable development and thus affect the economic development of the region [1-4]. The society perception of the



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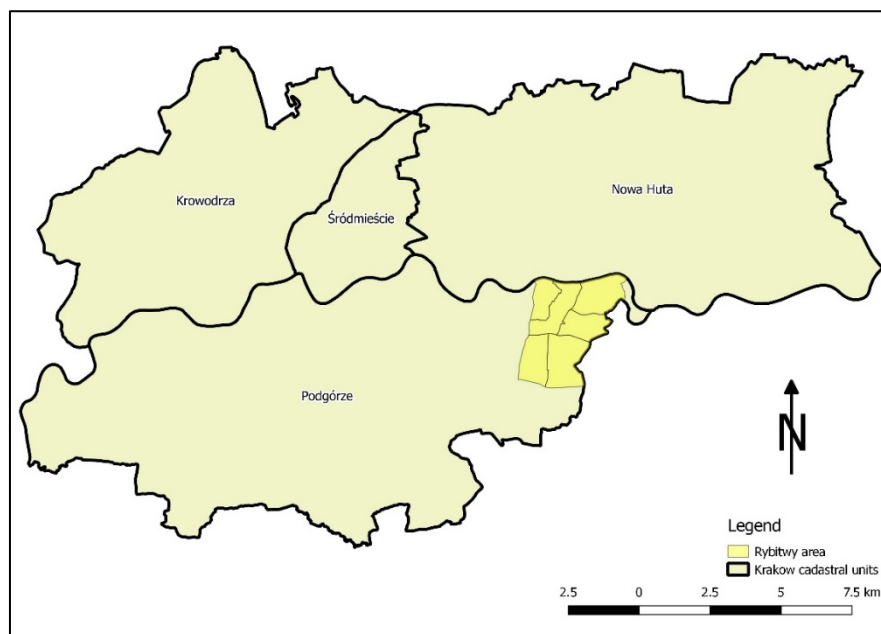
investments may vary. The location of a garbage dump or an industrial plant will be perceived negatively. On the other hand, other investments may have a positive impact on the environment and neighborhood. Infrastructure investments covering the development of the road network should be accounted to this type of investments [5-7]. The implementation of infrastructural investments related to the development of the road network is a key element that gives the region the opportunity to develop. The dynamic expansion of the local road infrastructure causes an increase in demand for, among others, warehouses or industrial facilities. From the entrepreneur's point of view, the necessary condition for the possibility of developing the business is the implementation of infrastructure investments and the choice of the location of buildings in relation to the local and regional communication routes is a strategic decision. Moreover, long distances combined with the poor condition of the road infrastructure generate additional transport costs, what, as a result, is intended to reduce the economic potential of a given region and, therefore, to stop its development [8-11].

The aim of this publication is to show a close relationship between the development of the communication system and the development of areas for construction of buildings with a warehouse and industrial function. The research was carried out in three stages. The research area includes the logistics center of Krakow.

The research results emphasize the important role of the road infrastructure planning in terms of the location of industrial and storage areas, as well as the location of special economic zones. In addition, they can be used by investors in choosing the optimal place for location of the facilities necessary for running a business.

## 2. Research area

The research area covers the Rybitwy area considered to be the logistic center of Krakow. This area is a part of the Podgórze cadastral unit. The Rybitwy area has no strictly defined administrative borders, therefore the study covered 6 precincts with a total area 1,189.94 ha (Figure 1).

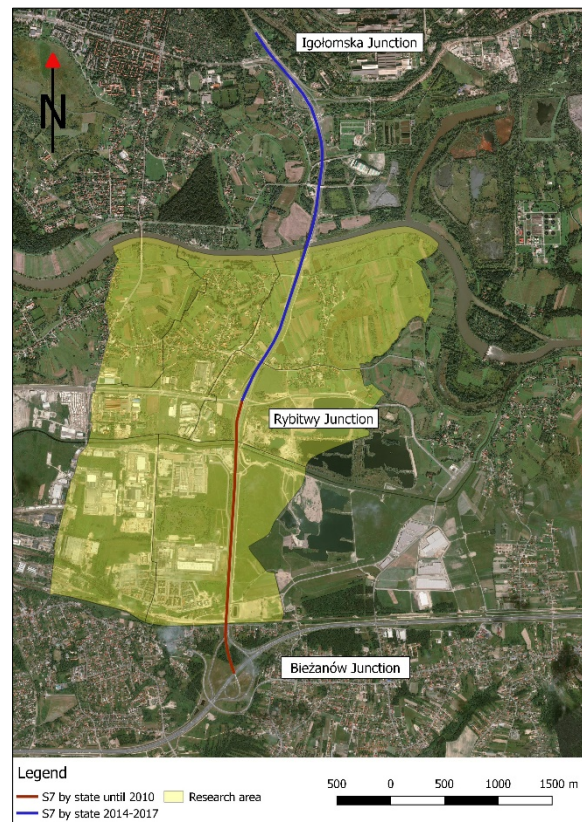


**Figure 1.** Location of the research area [own elaboration based on GIS Support].

Rybitwy it is a very important area for Krakow's economic development. It owes its reputation to an excellent communication system, thanks to the location in the vicinity of the eastern bypass of Krakow, which is a part of the S7 expressway. The S7 expressway is a route connecting south of

Poland with its north end. Ultimately, it will combine four agglomerations: Gdańsk, Warsaw, Kielce and Krakow. Rybitwy have gained importance already in the first stage of the S7 road construction, on the section from the Biezanów Junction to the Rybitwy Junction (Christo Botewa Street). This investment was carried out in the years 2008 - 2010. This route is located in the immediate vicinity of Rybitwy (Figure 2). Thanks to the construction of the aforementioned section of the beltway, and in particular the Rybitwy junction, these areas have become extremely attractive for investors. Close and very good access to the beltway resulted in the location of many companies in these areas, and hence the growing interest in renting warehouse buildings and production halls [12].

The next significant stage in the development of the studied area was the construction of the S7 route on the section from the Rybitwy Junction (Christo Botewa Street) to the Igołomska (Street) Junction. The implementation of this investment lasted from July 2014 to June 2017 (Figure 2). As part of the investment, a 4.5 km section of the dual carriageway expressway was built, with three belts in each direction, as well as two parallel bridges on the Vistula River, about 706 m long and 696 m long. These bridges are the longest of this type in Małopolska [12].

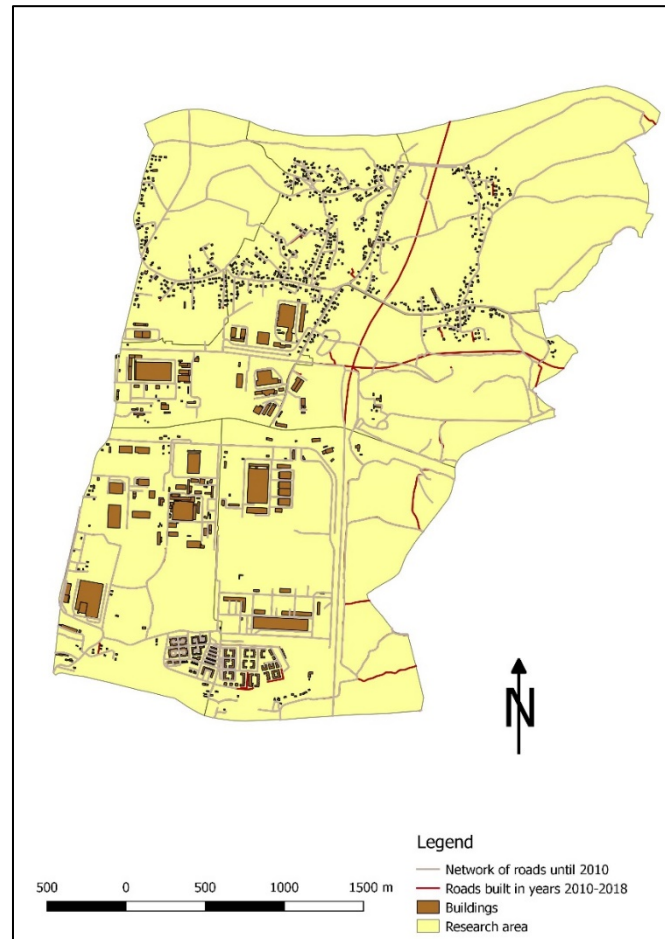


**Figure 2.** The route S7 on the section Rybitwy Junction - Igołomska Junction [own elaboration based on GIS Support].

Research on the number of warehouse buildings and production halls built on the area of Rybitwy during the implementation of the S7 route was carried out in three stages. The first stage is the analysis of the Rybitwy area in terms of the development of the road network. The second stage involves an analysis of the number of buildings and their area in 2008-2018. The third stage is the indication of competitive areas in relation to the analyzed research area [12].

### 3. Results and discussions

By 2010, the road network in the analyzed area was 77.79 km long. In the next 8 years, ie until 2018, only 4.16 km of roads were added. However, these are strategic sections, covering the construction of bridges on the Vistula River. The course of the road network during the period considered is shown in Figure 3.

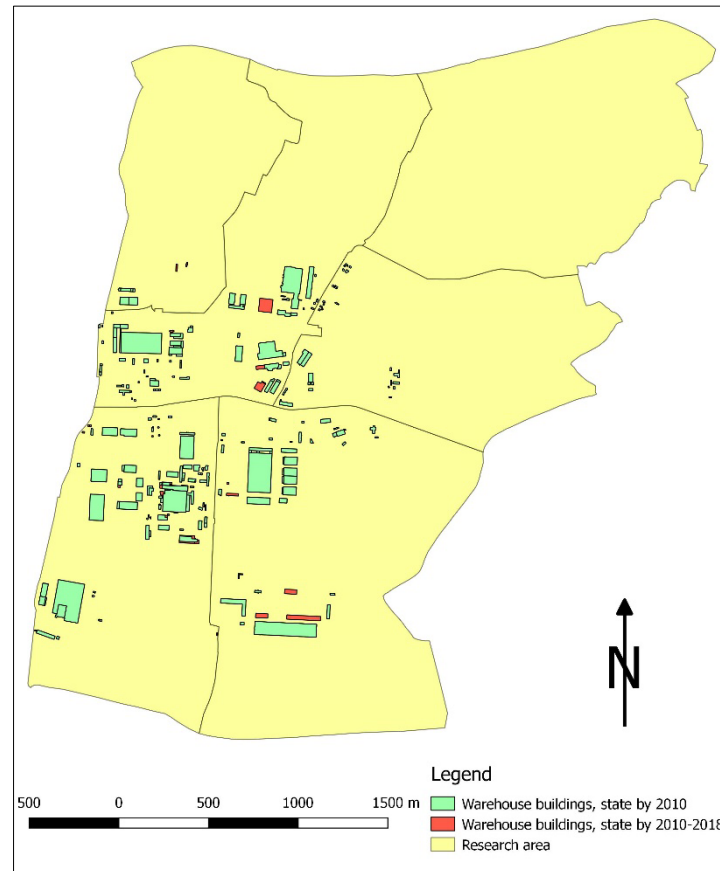


**Figure 3.** Road network up to 2010 (gray color) and built in the period 2010-2018 (red color) [own research, based on BDOT10k and GIS Support data].

The development of road infrastructure was closely related to the successive development of the Rybitwy area. Over the years 2010-2018, 11 buildings with a warehouse and production functions were created in the studied area, figure 4, with a total area of 19.094 m<sup>2</sup> (Table 1).

**Table 1.** The number and area of buildings in the studied area.

Specification	Number of buildings	Area of buildings [m <sup>2</sup> ]
<b>Status for 2010</b>	246	334,202.33
<b>Status for 2018</b>	257	353,296.37
<b>Difference</b>	11	19,094.04



**Figure 4.** Warehouse and production buildings built until 2010 (green color), in the period 2010-2018 (brown color) [own research, based on BDOT10k].

All buildings located in the studied area are offered for rent. The areas are adapted to the individual needs of tenants. The degree of adaptation of individual objects is agreed directly with the tenant according to his preferences. This solution is optimal for both the tenant and the landlord. Currently, production, trade and service companies as well as custom warehouses have their headquarters in this area.

In order to investigate the increase in the attractiveness of the location of the Rybitwy area, due to the expansion of the communication system, the research period was divided into two parts. The first part of the research covers the years until 2010, when the construction of the first part of the beltway from the Biezanów junction to the Rybitwy junction was completed. The second part of the research covers the years from 2010-2018, that is after completion of the construction of the second stage of the beltway [12].

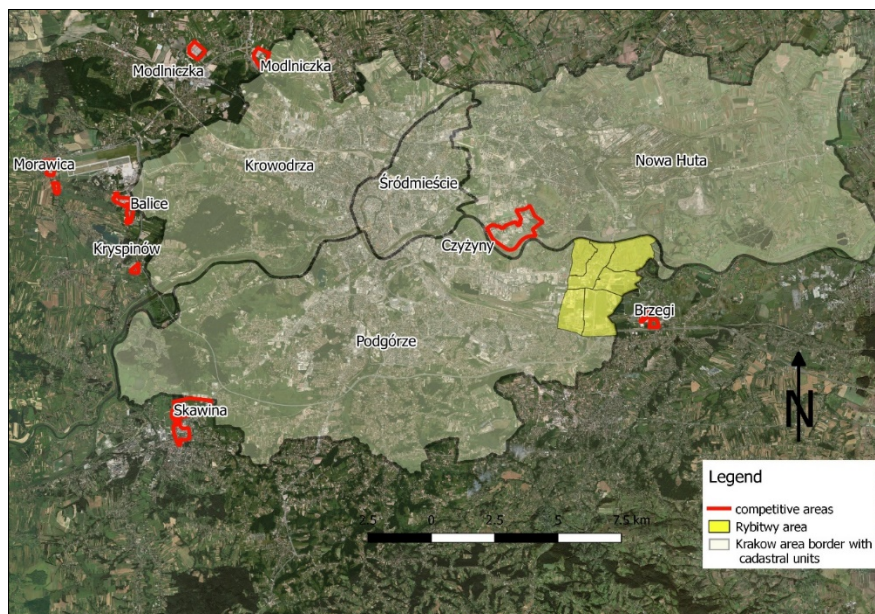
The degree of leasing the area was changing significantly. Before 2010, approximately 70% of all space was leased, which was 233,941.63 m<sup>2</sup>. Currently, 90% of all space is leased, which is 317,966.73 m<sup>2</sup> (Table 2). Attention should be given to the total area designed to be rented. A significant increase of this area is related to the construction of new warehouse facilities, including office and social rooms, with a total surface area equal 19,094 m<sup>2</sup>. It is worth noting that newly constructed buildings are 100% leased, and a 20% increase in the space rent is observed for buildings from the 80s of the 20th century. Taking into account the level of space rent before 2010 and the construction of new storage facilities (which are 100% leased), it can be concluded that the actual increase in rented space in old buildings is not 20% but nearly 30%.



**Table 2.** The degree of space renting.

Specification	Degree of rent	Area rented [m <sup>2</sup> ]	The total area for rent [m <sup>2</sup> ]
<b>Status for 2010</b>	70 %	233,941.63	334,202.33
<b>Status for 2018</b>	90 %	317,966.73	353,296.37

Economic development and the establishment of new trade enterprises contribute to the increase in the demand for warehouse and production buildings. Many companies import goods from contractors, not only domestic, but also foreign ones. These companies are interested in renting warehouse buildings located both in Krakow and in the Krakow region. For the needs of the conducted research, the places which were considered the greatest competition for the area of Rybitwy were highlighted (Figure 5). These include: Czyżyny, areas adjacent to the Airport in Balice, Skawina and Wielicka Economic Activity Zone [12].

**Figure 5.** Competitive areas for the Rybitwy area.

The biggest threat to the area of Rybitwy is the Wielicka Economic Activity Zone (WSAG). This zone owes its location to the neighborhood of the A4 motorway, running through Poland in the east-west direction, as well as the location of the S7 expressway. Transport accessibility, combined with proximity of the Kraków agglomeration, contributed to the creation of the zone in this very place. Moreover, in 2008, the concept of establishing a zone called Program and spatial project for the Wieliczka Economic Activity Zone was prepared. This date is important because it coincides with the date of construction of the first section of the S7 road. The authorities of the Wieliczka municipality used the location potential of these areas very well. During the preparations for the World Youth Days in Krakow, the roads and sidewalks were created in today's WSAG area, implemented with co-financing by the European Union under the Małopolska Operational Program. In total, 9 km of roads were created in this area. The first warehouse building being a part of the WSAG was commissioned in December 2015. At the date of the analysis over 30,000 m<sup>2</sup> of warehouse and production space were built there.

#### 4. Conclusions

An efficient and well-developed road network is the foundation for the development of the real estate management. In the case of development of the local road infrastructure, the demand for buildings

with a warehouse and production functions is growing. As a result of the research, the huge impact of the S7 expressway construction on the development of the studied area was noticed. In the years 2010 - 2018, over 19,000 m<sup>2</sup> of warehouse and production space was built in the studied area. This indicates an increase in the attractiveness of this area for investors. In addition, in the area under examination an increase in the level of space rent in storage and production buildings has been noted. Before the construction of the beltway, it was at the level of approx 70% of the entire area intended for rent. Currently, the coefficient is equal 90%.

Expansion of the road network in the analyzed area, contributed to the increase of the attractiveness of the area in the Wieliczka Commune, directly adjacent to Krakow. The Wieliczka Economic Activity Zone was established there, being the direct and the biggest competitor to Rybitwy area.

As results from the conducted research, the communication system plays a very important role in the development of areas designated for development with warehouse and production buildings. It is the well-developed network of roads that determines the development of a given region.

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