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Temps de déplacements en transport public à Bruxelles : l'accessibilité des pôles d'activités

Verplaatsingstijden met het openbaar vervoer in Brussel: de bereikbaarheid van de activiteitenpolen

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AUTHOR'S NOTE

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Introduction

1 In recent years, mobility has gradually become one of the main challenges faced by cities. In Brussels, the problems encountered are exacerbated by strong demographic growth,[1] which increases the demand, as well as by the high number of commuters, with the Brussels-Capital Region (BCR) constituting the main centre of employment in Belgium [Lebrun et al., 2012; Hubert et al., 2013].

2 In concrete terms, on a weekday, it is estimated that more than three million journeys are made in connection with BCR [Hubert et al., 2013: 3]. Among these, the majority of incoming and outgoing journeys in the Region are made by car[2] (63 %) [Lebrun et al., 2014: 15], whereas cars represent only half as many of the journeys within Brussels (32 %).

But this observation hides another reality: despite more and more multimodal practices [ibid.: 35], cars still account for close to half (48 %) of the distance represented by these journeys within the city, whereas they account for two-thirds of all of the journeys in connection with Brussels, which has an impact on the health and the quality of life of the inhabitants of Brussels.

3 This observation shows us that the challenge of implementing more "sustainable" mobility remains significant, for the journeys within Brussels as well. This raises the question as to the ability of the public transport service to compete with cars. But in addition to efficiency, the question of spatial equity is also important. In a Region with a relatively small surface area such as Brussels, which is served by four public transport operators, the aim for more uniform accessibility – at least to certain key destinations – does not seem to be unrealistic and would help the inhabitants to modify their mobility practices in a sustainable manner.

4 These two aspects must therefore be measured and discussed jointly. We shall therefore examine the accessibility by public transport of a selection of major poles of activity from neighbourhoods of Brussels. These results shall then provide more insight regarding better service.

5 In practical terms, this article is structured as follows: the first section (1) presents a brief discussion of the notion of accessibility and its use in the context of Brussels. The second section (2) provides details regarding the study case and the methodology. The third section (3) presents an assessment of accessibility, and the following section (4) discusses the areas for improvement with respect to their potential impact on the accessibility of neighbourhoods.

1. The concept of accessibility and its use in Brussels

6 Today, the concept of accessibility is used in various contexts and may have very different meanings [Richer and Palmier, 2011]. With respect to the area of spatial mobility alone, accessibility has been discussed very widely in the literature for many years.[3] The literature has led to many formalisations and possible measures which have also been the subject of summaries and classifications. According to the most complete definitions, accessibility covers up to four components, which have a mutual impact on each other: transport, spatial, temporal and individual [Geurs and Ritsema Van Eck, 2001], without it being possible or desirable to incorporate all of the dimensions into the measures.

7 In our study, from a geographical perspective, accessibility is defined by the degree of ease involved in going from one place in the city to another, i.e. a more general perspective than the physical accessibility of infrastructures and vehicles (which it might include). It is considered above all in its transport component, with the objective being to evaluate the performance of public transport in a simple and legible way via the measurement of travel times.

8 Let us note that in the world of research, measurements of accessibility by public transport in Brussels are not very abundant, even though it seems to be the subject of a growing number of works in recent years. Thus, to our knowledge, the first study of this type regarding Brussels was conducted in 1995 [Dobruszkes and Marissal, 1995]. It was aimed in particular at deconstructing the rationale behind the use of cars (lower costs, symbol of freedom, etc.) and included a series of accessibility measurements, using the

Central Station as a starting point. More recently, Lebrun et al. [2012] carried out a succinct measurement of the average accessibility of the Region and Leclercq et al. [2015] applied a modelling of accessibility via co-modality (car and public transport) to the Brussels metropolitan area, by targeting the big stations. Finally, Leurquin [2016] modelled accessibility from certain residential areas and examined the question of the establishment of Park and Ride facilities. Our work is aimed at describing the accessibility of the Brussels area for a selection of major poles of activity from all of the neighbourhoods, and to relate it to the population volumes concerned.

9 The regional administration uses the notion of accessibility in a more continuous manner, in connection with the elaboration of different mobility plans (Iris) and development plans (PRD). Nevertheless, these policy documents often explain very little about the measures to the general public and, in terms of accessibility, only the *Règlement Régional d'Urbanisme* (RRU) constitutes an exception given its regulatory nature.[4]

10 In this framework, our work is also an occasion to present recent results, obtained according to a simple measurement, in the framework of a methodology which is intended to be as clear as possible (cf. following point). It is also the result of a collaboration with the regional administration (Bruxelles Mobilité), which recently implemented a multimodal model of journeys (MUSTI) in 2013, i.e. a measurement and decision-making tool concerning various problems related to mobility (flow descriptions, tests for different scenarios, etc.).

2. Measuring the accessibility of poles of activity

11 The measurements were made using two successive tools. The first was the calculation module of travel times of the strategic multimodal model for journeys in the Brussels-Capital Region, which allowed the calculation and/or extraction of pertinent data from the transport service at a detailed spatial scale, i.e. that of the 724 statistical sectors in Brussels (hereunder referred to as either neighbourhoods or sectors). Subsequent processing and the use of GIS software then allowed the calculation and the mapping of indicators.

12 In concrete terms, the statistical sectors were represented by a point corresponding to their geometric centre (also called centroid). Each point was then linked to several public transport stops,[5] chosen among those which were the closest to the point in question. The chosen stops therefore play the role of connector, allowing travel on the public transport networks. They were generated according to a procedure which adhered to specific rules.[6]

13 Accessibility was then evaluated at the origin, according to the median time required to travel from the centre of a sector to the centre of another. As we wished to evaluate the accessibility of the inhabitants of Brussels with respect to a selection of poles of activity during the morning rush hour, two filters were applied: one at the origin, excluding the inhabited or very sparsely populated sectors (less than 20 inhabitants), and the other at the destination, by selecting ten sectors representing a panel of major destinations.

14 In detail, the significant poles of activity which we have considered include the three major stations of the North-South railway link (Brussels-North, Brussels-Central and Brussels-South), which correspond to major centres of employment, as well as being important transit points, in particular to the STIB network (underground) and that of

De Lijn (Brussels-North). Although it is geographically close to the Central Station, the consideration of the Bourse neighbourhood allows us to include, more significantly, journeys which are unrelated to work. This neighbourhood constitutes a major commercial and cultural centre, where many journeys are made each day, in particular by tourists, including during rush hour. As main centres of service sector employment in the Region, the Rogier, Schuman and Luxembourg neighbourhoods also generate many journeys during rush hour, in particular in connection with the federal and European administrations located there.

15 These first seven destinations constitute (examples of) major destination centres during rush hour. But in order to reflect a greater diversity in the reasons for travelling,[7] four other destinations were added to these. Firstly, these included two hospitals, Brugmann and Saint-Luc, which allowed a diversification of the geography of the destinations, while taking into account the access to this type of service (either as a patient or a visitor, but also as a worker and/or a student).[8] Finally, the neighbourhoods of the Solbosh university campus (ULB) and those of Place Flagey complete the panel. They were chosen for their strong functional mix, combining a residential and a commercial function, as well as an educational and employment centre in the case of the ULB neighbourhood.

16 With this approach, the selected areas form a sample testifying to the possibility of travelling during rush hour for various reasons, including work, going to hospital or going shopping. As the selection of areas already gives particular focus to journeys connected with work, it was decided that this part would not receive special attention, thus giving each destination an identical weight.

17 This selection of areas is based above all on general empirical knowledge of the transport demand in Brussels during rush hour and is not the result of a strictly quantitative approach. We may, however, note that the destinations selected represent more than one third (35 %) of local employment[9] in Brussels and include in particular the five busiest stations in the Region. This approach to accessibility is in keeping with that proposed by El-Geneidy et al. who referred to the ease of reaching destinations of interest.

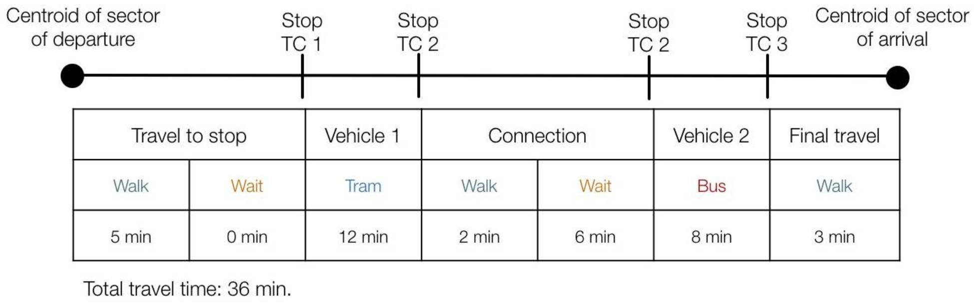
18 Another way to proceed would have been to weight our measurements according to the demand, but this mainly concerns an origin-destination pair and has the disadvantage of being poorly understood, particularly at a detailed geographical scale. Rather than weighting the values directly with an approximation of the demand (population, jobs), which would not have guaranteed consistency with the actual flows, we chose to apply a filter on the origins and on the destinations in particular. This allows us to use "simple" values of travel time, and to relate the results obtained to the number of inhabitants of Brussels who are potentially concerned by the analysis.

19 In concrete terms, the time measured is based on the timetables of the different operators, and includes walking time from the centre of the sector of origin to the public transport stop and vice versa at the end of the journey (calculated according to a distance as the crow flies, at a speed of 4 km/h), as well as the possible connection times. The waiting time for the first service is considered as nil, which implies that the timetable at the place of departure is known by the users. An example of the different times is provided in Figure 1.

20 Concerning STIB, let us specify that the timetables are as close as possible to "real" time, to the extent that they are elaborated based on travel times gathered by the intelligent

transport system (ITS) used by STIB vehicles, excluding exceptional situations [Lebrun et al., 2012: 62].

Figure . Segmentation of a typical journey illustrating the different times considered



21 From a time-based perspective, we have considered the connections whose departure is in the time period between 8am and 9am and arrival in the time period between 8am and 10am, on a weekday.

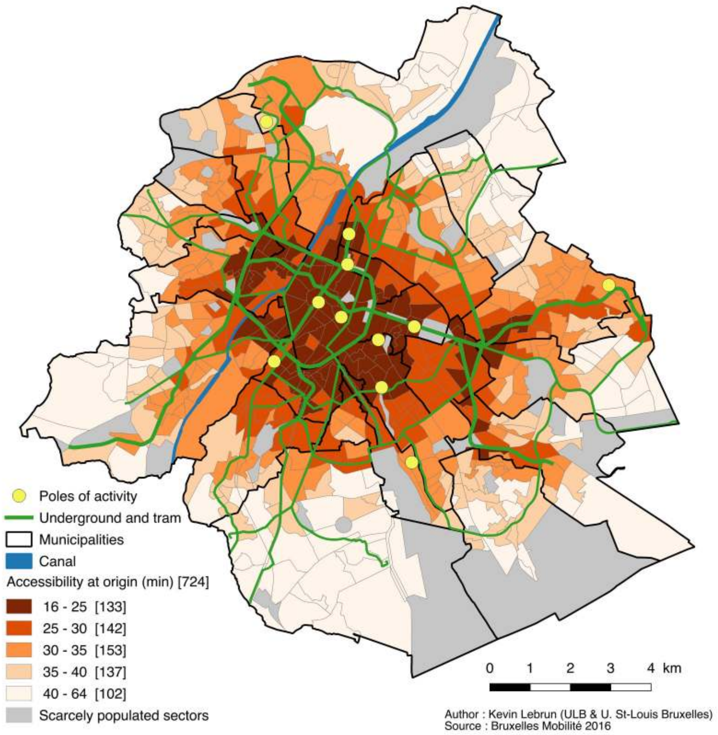
22 Finally, while several measurements of travel time were possible (best time, first decile, etc.), we have chosen median time for two reasons. Firstly, because, with respect to more optimistic measurements, the median time greatly limits the positive effect of efficient yet infrequent services such as the train. Furthermore, median time has the advantage of being representative of the journeys of a larger number of people, particularly with respect to the best time, related to practices of people in good health, with rational behaviour (in the usual sense) and who are able to take advantage of the best opportunities for their journeys.

3. Accessibility of neighbourhoods in Brussels to the poles of activity in 2016

3.1. What do STIB services offer?

23 Taking into account the transport service of the main operator, the average travel time towards our panel of destinations is 32,4 minutes.[10] It therefore takes just over half an hour to reach the main poles of activity during the morning rush hour. However, this average value masks the diversity of existing situations, as the times range from 16 to 64 minutes according to the sector of origin considered.[11] Figure 2 details the geography of these average times.

Figure . Access times to the poles of activity via STIB according to the median time during the morning rush hour, on a weekday



24 We can see that the levels of accessibility are situated overall in a concentric manner and decrease towards the outskirts of BCR, as the travel times increase.

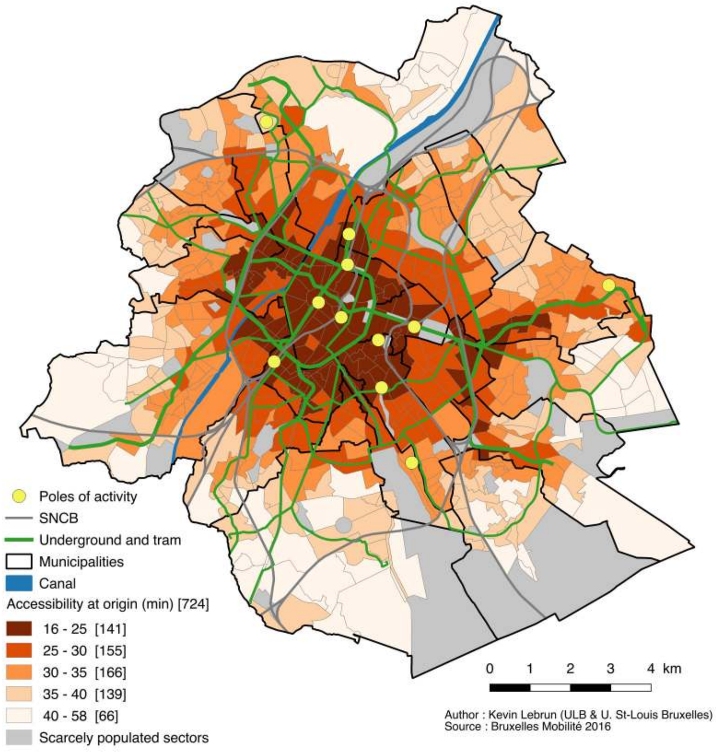
25 Thus, the areas with the best conditions for access (less than 25 minutes) towards the chosen poles of activity are the Pentagon and its outskirts (north neighbourhood, European neighbourhood, north of Saint-Gilles and Ixelles, etc.). Some areas further away from the centre (Mérode, Simonis) also emerge. The second category (between 25 and 30 minutes) includes mainly the inner ring of BCR, with a more developed surface to the east (up to the boulevards of the outer ring). This level of accessibility continues in the outer ring along the (pre)underground lines, especially towards the east. In contrast, the areas with the most difficult access are all located in the outer ring of the city. This includes mainly the west of Anderlecht, the centre and south of Uccle, certain neighbourhoods of Auderghem and Watermael-Boitsfort (Transvaal, Coin du Balai, Logis-Floréal), Neder-Over-Hembeek, Haren and the east of Woluwe-Saint-Pierre. From these neighbourhoods – which represent approximately one hundred statistical sectors – it takes an average of 40 to 64 minutes to reach the poles of activity.

26 The access provided by STIB therefore appears to be very uneven, with two types of spatial logic which overlap: the most fundamental is the concentric type, followed by a more radial logic, in connection with the most efficient services, in particular the underground. And while the transport service is uneven by nature and guided by an imperfect awareness of the demand, we may nevertheless underline the extent of the observed heterogeneity, with the average times sometimes being four times as long,[12] for access to major poles of activity in Brussels from residential sectors during the morning rush hour.

3.2. Taking into account the other operators in Brussels

27 By including the SNCB, TEC and De Lijn services, the access times to the main poles of activity decrease slightly from 32,4 to 31,3 minutes. Likewise, the range of values decreases somewhat, varying between 16 and 58 minutes (Figure 4).

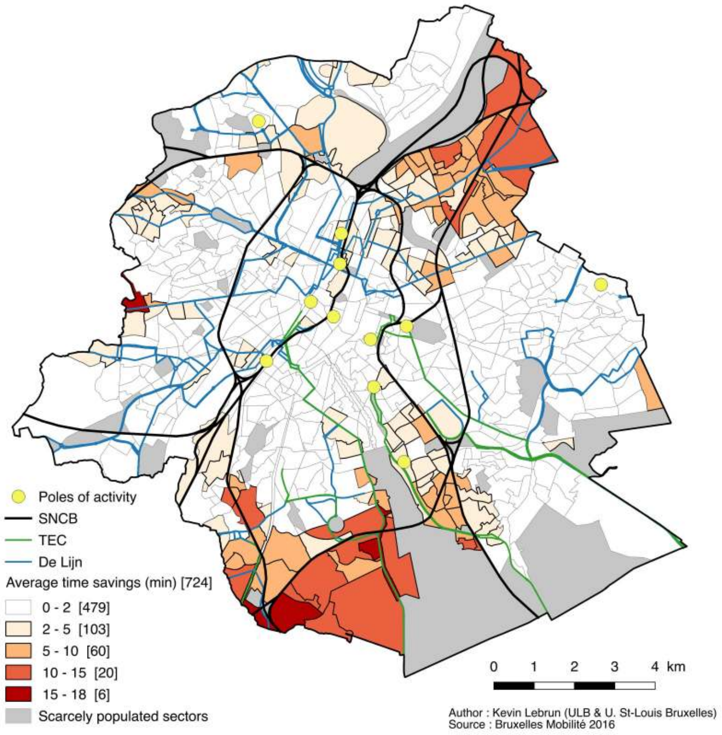
Figure . Access times to the poles of activity via all operators (STIB, SNCB, TEC, De Lijn) according to the median time during the morning rush hour, on a weekday



28 In spatial terms, we see that the variation in accessibility is still structured in a concentric and radial manner overall. The SNCB and De Lijn transport services are both very centralised and are limited for the most part to a few major roads for entering the city (Chaussée de Ninove and Chaussée de Louvain for De Lijn, for example). For journeys originating inside the Region towards the poles of activity, this additional service therefore has a positive effect, but appears to be limited overall.

29 The previous representation does, however, mask potentially significant absolute differences. This is why, in Figure 4, we have subtracted the values obtained for all operators from those obtained for STIB alone. This allows a visualisation of the contribution made by operators other than STIB.

Figure . Contribution made by other operators to access times in BCR, according to the best time available during the morning rush hour, on a weekday

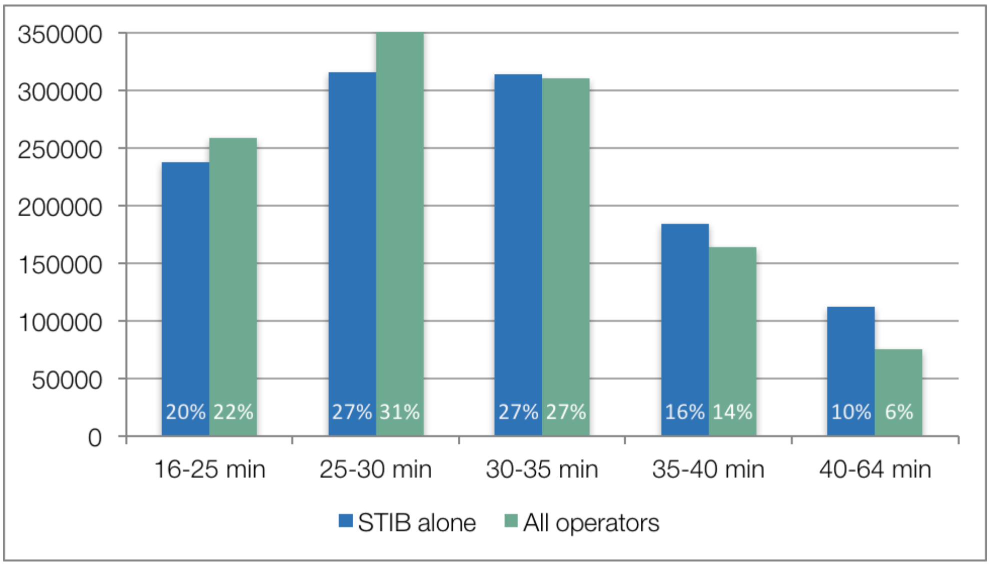


30 For most sectors, the effect of other operators is (almost) non-existent, which may be due to a lack of service or to the fact that the proposed service does not allow an improvement of the best time proposed by STIB alone. But we also see that the sectors which benefit from a significant improvement form relatively adjacent areas, and that this improvement is especially significant for three areas: Evere and Haren (as well as certain sectors of Schaerbeek), Berchem and Ganshoren, centred on the boundary between these two municipalities (Avenue Charles-Quint) and, above all, the south of Uccle, extending eastward towards the south of Brussels-City and Ixelles, as well as towards the west of Boitsfort.

31 For the south of Uccle, the savings may reach 18 minutes on average. In this case, this is due to the impact of the SNCB service along lines 26 and 124, as well as that of TEC and De Lijn (Chaussée de Waterloo in particular).

32 Beyond travel times and the spatial structure which have been highlighted, it is important to examine the suitability of this service with respect to the transport demand, which, in our study case, may be estimated with respect to the resident population (Figure 5).

Figure . Volume and share of the population of Brussels according to the categories of accessibility



33 In doing so, we see that the neighbourhoods in the best categories of accessibility thankfully include the majority of the population of Brussels. But we also see that the worst category, which includes the sectors located more than 40 minutes from the poles of activity on average, concerns close to 10 % of the inhabitants of Brussels, i.e. 112 000 people (the equivalent of the population of the municipality of Anderlecht), which raises the question as to better access to the urban poles of activity for these people. In this case as well, we see that the situation improves when all of the operators are taken into consideration, in particular for the worst category, which underlines once again their important role for these unlucky inhabitants of Brussels.

34 Finally, we see that the contribution of the other operators may be significant locally, although their lower frequencies give them a more limited advantage in our metrics based on median time.

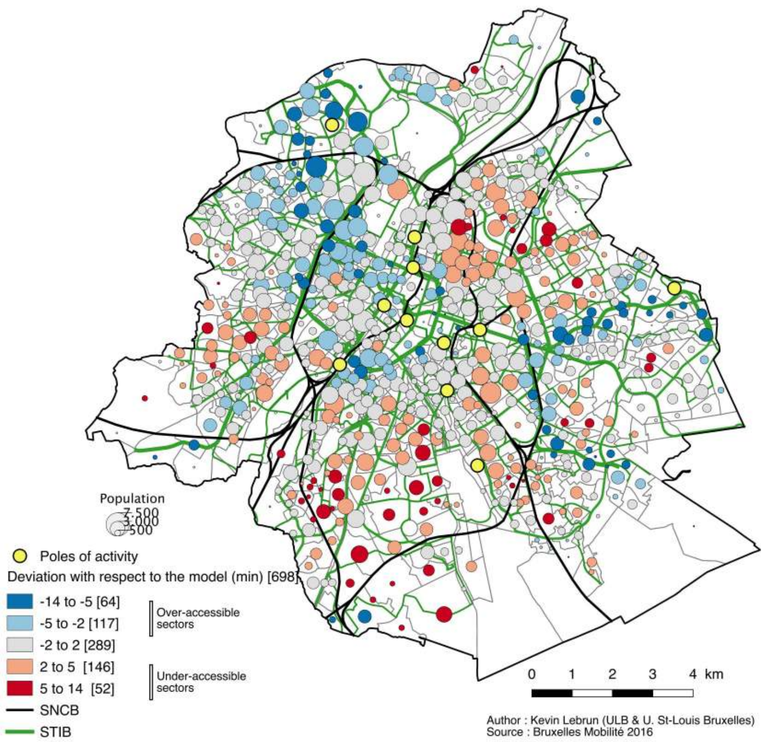
3.3. Beyond centrality: a relative view of accessibility

35 Figures 2 and 3 have shown us that accessibility follows a concentric model above all. In order to test this relationship formally, accessibility was the object of a linear regression with a geometric variable: the average distance (as the crow flies) separating the different sectors. This regression provides a correlation coefficient of 0,71 (p-value < 0,001), which indicates that the variability in the distance alone allows a description of 71 % of the variability in travel times (all operators).

36 This strong relationship naturally accounts for a fundamental geographical effect, with all areas free from interruptions, as they are more accessible at their centres than at their edges. Furthermore, as soon as we realise that the transport supply and demand adapt mutually over time, we may maintain that this effect is in all likelihood reinforced in Brussels by the configuration of employment (and more broadly of activities), which also has a concentric character (preserved via the poles of activity considered in the sample). Likewise, the population densities decrease from the inner ring towards the edges of the outer ring (as the city centre is not less densely populated than in the east).

37 But while geometric centrality as well as that related to supply and demand in Brussels allows an "explanation" of approximately 70 % of the variability in accessibility in Brussels, we may therefore wonder what accounts for the remaining 30 %. This share is not explained by centrality – also referred to as residue in the framework of mathematical regression – and was therefore mapped in Figure 6. This new representation, which in a sense neutralises the effect of centrality, allows us to describe, at an equal average distance, the areas with better or worse accessibility than expected. The results are weighted visually by circles proportional to the resident population.

Figure . Access times in BCR for all operators, considering average distance to the other sectors and resident population, during the morning rush hour, on a weekday



38 On this map, the colour red indicates the sectors whose accessibility is worse than expected given their relative position, and conversely for the colour blue. The colour grey indicates a small deviation with respect to the model.

39 The advantage of the (pre)underground is therefore very clear, in particular at the extremities of its various branches, for travel within the Region. But the underground is apparently not the only mode which provides such an advantage. Other areas on the outskirts – which correspond to areas served by the railway – also stand out (Moensberg, Haren, Jette, Ganshoren, etc). Despite the low frequency of trains (which is penalised by our median measurement), the neighbourhoods of these stations nevertheless benefit occasionally from over-accessibility comparable to what is seen with the underground, in relation to very good travel times. Let us note the over-accessibility around Simonis, where underground, tram and bus combine to provide better times than expected, despite a geographical position which is not so out of the way.

40 Conversely, the areas which are less accessible than expected include certain areas of the outer ring of the city, in particular those which are not served by the underground (the

north of Anderlecht, Boitsfort and Uccle, where there is a concentration of the highest values), but also, more surprisingly, large areas of the inner ring in Schaerbeek and Ixelles in particular.

41 In relation to the population of Brussels, the effect of poor relative performance is rather significant, in particular as it involves large parts of the municipalities of Uccle, Ixelles Etterbeek and Schaerbeek. In total, the population in the neighbourhoods characterised by under-accessibility of the poles of activity of at least two minutes on average represents 340 000 people (29,2 % of the population of Brussels), or 65 000 people (5,6 %) if under-accessibility of at least five minutes on average is considered.

42 Finally, while it is easy to explain the strong heterogeneity of the absolute measurement in relation to centrality and the demand – with these two aspects overlapping greatly in the case of Brussels – it is more surprising to see that the heterogeneity remains significant with our relative measurement. The latter constitutes an interesting perspective, which could serve as a basis for the elaboration of a regional objective aimed at reducing the gaps within Brussels. Minimising the relative differences would allow more sustainable mobility practices to be supported in connection with an easily assessable level of accessibility, as it correlates better to centrality. At the same time it is politically defensible, as everyone understands that it is not possible to demand an equal level of service for those who live in the city centre and those who live on the outskirts of the Region.

4. What are the margins for improvement?

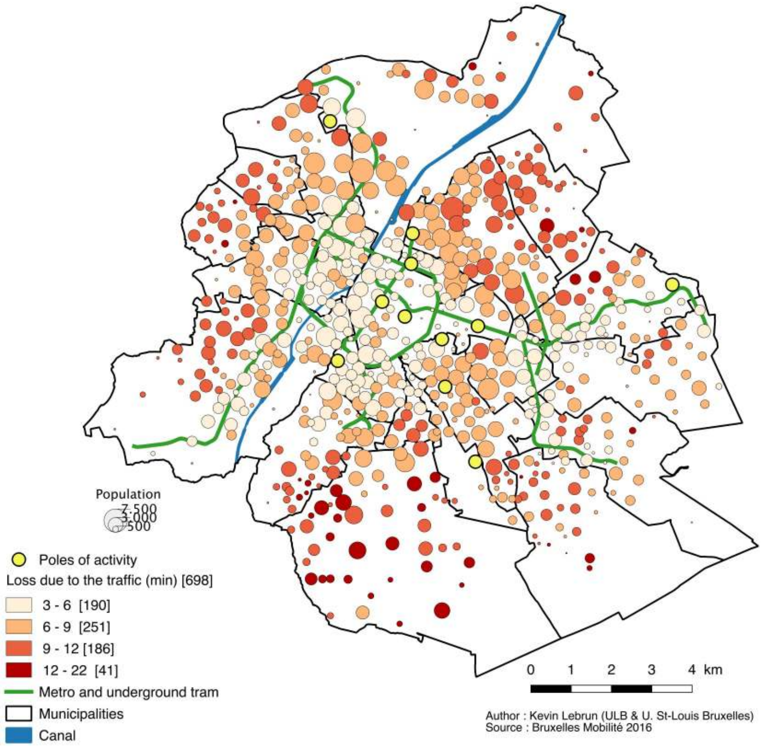
43 If we look at Figure 6 once again and re-examine the contrasts, we notice that the geography contrasts the efficiency of the underground networks and the worse performances of neighbourhoods served only by surface transport (tram and bus). This is very clearly related to the traffic conditions faced by the surface networks, which are taken into account via the timetables.[13] This reality a has already been highlighted in Brussels [Dobruszkes and Fourneau, 2007; Courtois and Dobruszkes, 2008].

44 In order to evaluate the negative weight represented by the traffic conditions on the accessibility of neighbourhoods, a fictional service was elaborated, including rush hour services (identical lines and frequencies), and attributes the best existing profile of travel times to each line. This new network therefore does not correspond to a unique timescale: while the best times are often at the end of the evening, this is not necessarily the case for all of the lines.

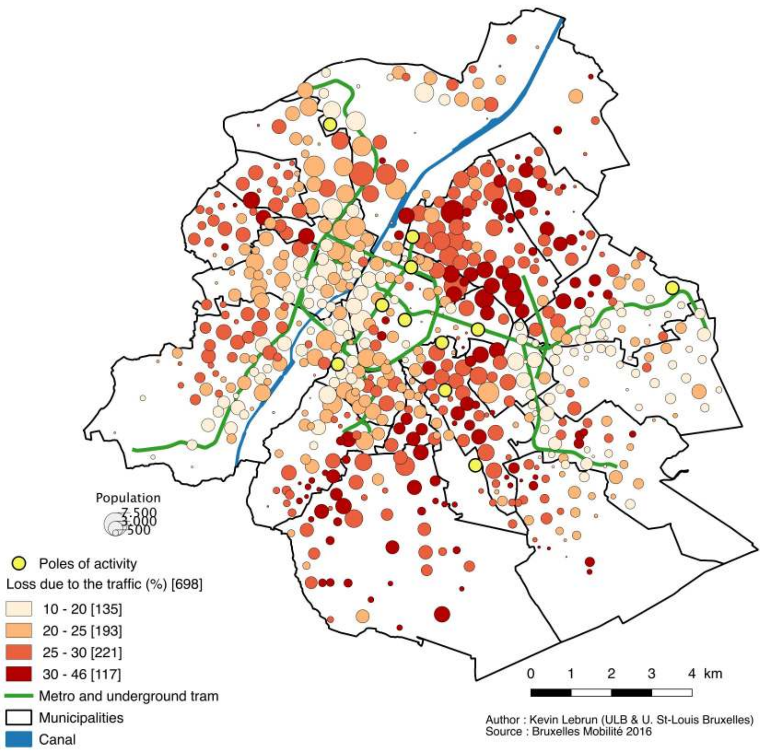
45 In doing so, we therefore compare the usual rush hour network to an identical service with the best possible travel times in 2016, which gives an idea of the time loss, and therefore of the potential for improvement.[14] (Figure 7)

Figure . Under-optimality of accessibility towards the poles of activity during the morning rush hour considering delays, according to timetables, all operators

a. Absolute loss departing from neighbourhoods (min)



b. Relative loss departing from neighbourhoods (%)



46 These maps therefore do not show the extent of the congestion where it is produced, but they distinguish the neighbourhoods where traffic congestion will have a certain impact on travelling to the poles of activity by public transport.

47 Thus, in absolute values (a), the average loss for all of the neighbourhoods amounts to almost 8 minutes. It even exceeds 12 minutes in many sectors of Uccle. The other neighbourhoods which are most concerned are located mainly in the northwest of the Region. In relative terms (b), it appears that our journeys are 25 % longer on average with respect to what the operators are already capable of today at the current level of service, with no delays. The geography is however different, as many areas of the inner ring of the city are included (Schaerbeek and Ixelles in particular), from which there is more than a 30 % loss of time (and up to almost 50 %) with respect to the optimal situation.

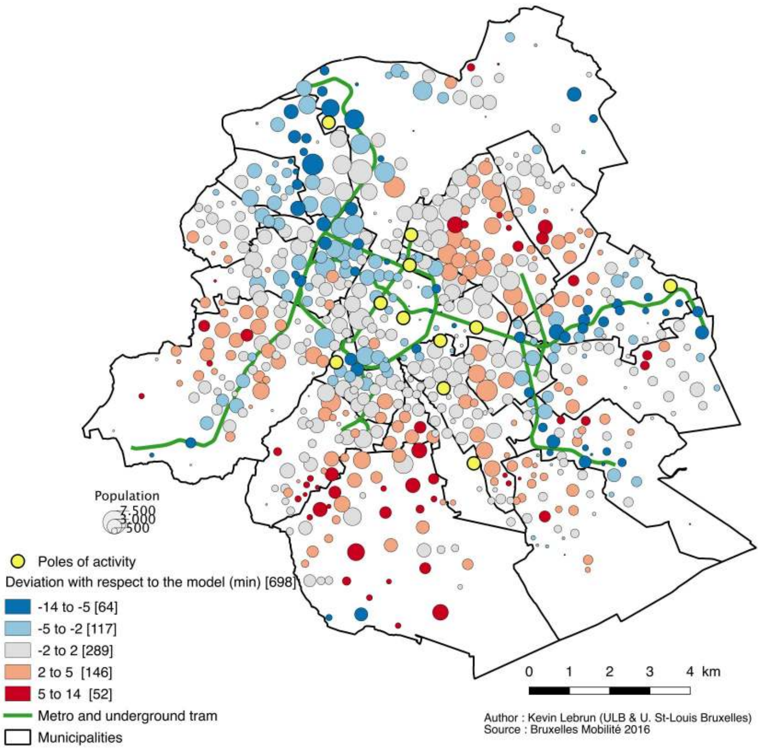
48 The delays therefore still have a strong impact on the efficiency of public transport, despite the current policies aimed at a gradual increase in the separation or the priority of public transport with respect to the rest of the traffic [Brandeleer et al., 2016].

49 Finally, this approach also allows an evaluation of the accessibility of neighbourhoods in optimal traffic conditions – comparable to those seen in cities which have reintroduced separate lanes for trams over the past decades, for example – and with centrality taken into consideration (Figure 8).

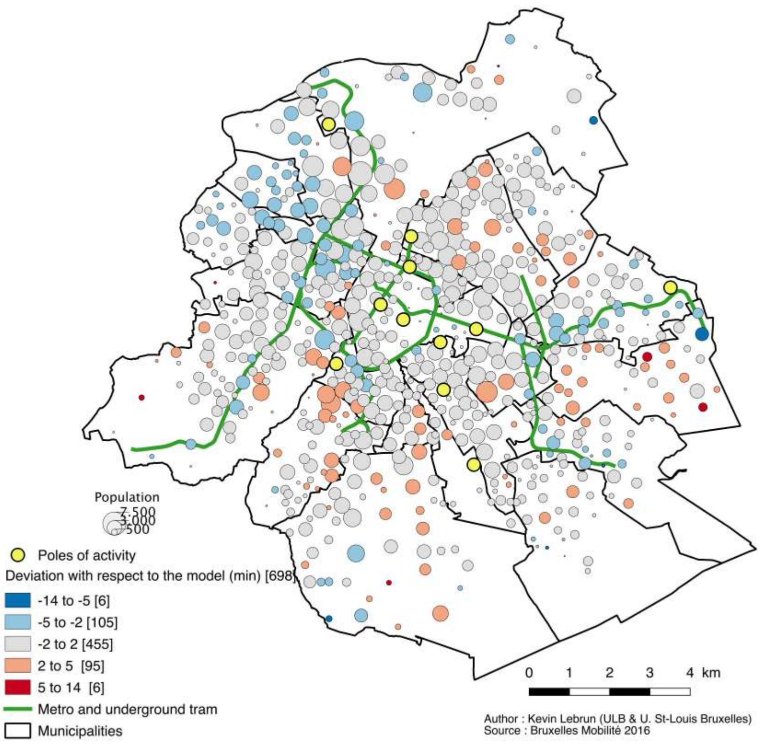
a. Over- and under-accessible neighbourhoods in current traffic conditions	b. The same, in optimal traffic conditions

Figure . Influence of traffic conditions on accessibility by all operators, considering the average distance to the other sectors, during the morning rush hour, on a weekday.

a. Over- and under-accessible neighbourhoods in current traffic conditions



b. The same, in optimal traffic conditions



50 The extent of over- or under-accessibility is strongly reduced in this case, with the most extreme categories having almost disappeared, whereas the central category now

represents 65 % of the sectors and 71 % of the population (41 % and 44 % respectively in the current situation). The effect is especially pronounced in Uccle, which shows that even without the underground, the tram and bus service is theoretically capable of putting the municipality at an acceptable level of accessibility given its position in the Region, provided that the vehicles are able to operate smoothly (and all things remaining equal in other respects, such as vehicle use).

51 These results thus raise the question as to the means to be implemented in order to free the services even more of car traffic.

Conclusion

A measurement of accessibility to direct public action

52 This study has shown that accessibility by public transport to the main poles of activity during the morning rush hour presents quite a varied picture, according to absolute time as well as considering distance to centrality.

53 The absolute perspective shows that the values can sometimes quadruple, and convey two types of spatial logic, i.e. concentric and radial. Although this observation was partly expected, our results show the extent to which centrality influences travel times, with the geometric effect reinforced in Brussels by the central position of the main poles of activity.

54 But it seems unrealistic to want to reduce the gaps by using this absolute perspective as a reference. Apart from the question of limits to be set, this type of objective proved to be very expensive given the low average number of users to gain in each of the potentially concerned neighbourhoods. Furthermore, this approach aimed at greater equality proves to be misleading in reality, to the extent that it would penalise the people who already benefit from good accessibility as they live in more central neighbourhoods, but who are more subject to the negative aspects related to higher densities (air pollution, noise, smaller private outdoor spaces, etc.).

55 Combined with a socioeconomic indicator, this vision could prove to be useful in making more targeted improvements, to the benefit of disadvantaged neighbourhoods which are considered to be too far from the poles of activity, in order to increase spatial and especially social cohesion in the Region.

56 The second perspective – which neutralises the effect of centrality – is more interesting, as it shows that beyond centrality (and the demand), other aspects may influence accessibility, such as the flow of traffic and the structure of networks via transfers. Thus, as a whole, the areas with poor accessibility due to their location represent close to 30 % of the population of Brussels. Surprisingly, they also concern neighbourhoods in the south and east parts of the inner ring of the Region, which benefit from quite a dense service network. Thus, as a whole, the areas with poor accessibility due to their location represent close to 30 % of the population of Brussels.

57 Contrary to the first measure, this could constitute the basis for a regional objective, which would consist in decreasing the proportion of the population in a situation of under-accessibility, by reducing the relative differences observed between neighbourhoods. The aim for more uniform accessibility in view of centrality seems to be

more coherent with respect to the advantages and disadvantages of urbanity, and also constitutes an interesting compromise between performance and (socio)spatial equity.

Operators other than STIB are part of the solution

58 How can the situation be improved in practical terms? Our results show that 10 % of the inhabitants of Brussels (approximately 110 000 people) are still located 40 minutes away from the poles of activity on average, which is not insignificant. The contribution of operators other than STIB in certain municipalities of the outer ring, such as Uccle or Evere, is already significant and allows this proportion to be brought down to 6 % overall. But one must be in a position to benefit from this. In this respect, let us bear in mind that the basic STIB pass does not provide access to the services of other operators in the territory of Brussels. A financial supplement is therefore necessary, which means that the inhabitants of Brussels are not inclined to discover and make use of these additional transport services.

59 However, in Brussels, better fare integration would mean not only better accessibility in general, but also reduced gaps, which many neighbourhoods in the outer ring would benefit from, as they are currently not as well served by STIB. This process must therefore be encouraged, so that the change of operator is no longer experienced at best as an obstacle to overcome, and at worst as an option which is not even considered. In a highly integrated system, the operator used is of secondary importance to travellers.

60 Furthermore, despite a measurement of accessibility which penalises low frequencies of service (median time), we have shown that the gain in time – provided by the train in particular – is sometimes so significant that it determines levels of accessibility comparable to those provided by the underground in the outer ring of the Region. This will not fail to support the idea that an RER could be a very useful addition to the underground network by increasing the frequencies of service to the medium-sized and secondary stations concerned (Uccle-Calevoet, Haren, Boitsfort, Jette, etc.). Many inhabitants and workers in outlying neighbourhoods could therefore compensate for the distance in a more constant manner throughout the day, with unbeatable travel times.

Controlling car traffic remains crucial

61 Our simulation shows that the impact of car traffic on travel time is substantial. Thus, when travelling to the main poles of activity during rush hour, the traffic conditions lengthen public transport travel time by 25 % on average, a figure which varies and may reach 50 % according to the neighbourhood of departure.[15]

62 Thus, the efforts made to remove trams and buses from traffic, either by creating separate lanes[16] or using a remote controlled traffic light system [Brandeleer and Ermans, 2016], are still not enough to benefit from the full potential of the current service and make it as efficient as it is in the cities which have reintroduced the tram in recent decades.[17] As regards the significance of the potential gain in time, while it is unrealistic to imagine being able to benefit from it completely, in return, we must also bear in mind that the estimate applies to an identical transport service, without the addition of any other vehicles in the network.

63 It is also ironic to note that even today, the service provided by different operators unburdened by car traffic, would provide rather uniform accessibility given the centrality, which is very close to the vision we have put forward.

Still other avenues to explore

64 Another potential lever for action resides in the organisation of transport networks, and particularly that of STIB. In recent years, the regional operator increased the frequency of many lines, potentially reducing the length of connections. But this rationale, although positive, has probably reached its limits with respect to rush hour, as certain urban lines are completely saturated, while our analysis of data from 2016 suggests that a reduction in the number of connections still constitutes a factor for possible optimisation. Given the inability to relocate the existing demand easily and quickly, the approach involving a reorganisation of the surface network – in particular the trams – should therefore be explored.

65 Finally, let us insist on the potential of such analyses, which have been carried out here only with respect to accessibility within Brussels during the morning rush hour. However, the regional travel model allows the exploration of other spatial scales (immediate outskirts, RER area) and time-based scales (off-peak hours, evenings), which would allow other issues to be dealt with, such as the complementarity of public transport and other modes, or the issue of social inequality.

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NOTES

1. This phenomenon has been observed for twenty years or so, with the result that BCR has exceeded its historical maximum of the 1960s and reached 1 191 604 inhabitants on 1 January 2017 [Hermia, 2018]. Brussels is not an isolated case, as this demographic growth is observed in 85 % of the urban regions in Europe and in most of the capital cities [ESPON, 2008].

2. With the modal shares calculated according to the main mode, which means that in the case of an intermodal journey, only the mode covering the greatest distance is considered. More information regarding the calculation of modal shares in Lebrun et al., 2014.

3. Let us mention in particular [Beaujeu-Garnier et al., 1975; El-Geneidy et al., 2011; Geurs, Ritsema van Eck, 2001; Handy, Clifton, 2001; Hansen, 1959; Karou, Hull, 2014; Litman, 2003; Merlin, 1992, 1991; Vandenbulcke et al., 2009].

4. This document divides the territory of Brussels into three areas of accessibility (A, B and C), which have constraints concerning the number of bicycle and car parking facilities. However, it evaluates accessibility based on mode and frequencies and not travel times [Brussels-Capital Region, 2006].

5. A stop corresponds to a boarding point on one of the public transport networks. For example, the number of stops at an underground station equals the number of platforms. All stops have precise locations.

6. Three rules have been used to select the stops connected to each centroid:

1. Each statistical sector must be linked to at least one STIB stop, with no limits in terms of distance.
2. Additional connectors are allowed according to a criterion of distance: 500 metres maximum towards any other stop, regardless of the operator.
3. A maximum of five connectors are allowed per statistical sector, in order to shorten the calculation time and with regard to the low value added by additional connectors.

7. Journeys related to school or work represent only part of the journeys made on a weekday [Lebrun et al., 2013: 11].

8. In detail, Brugmann was preferred above Plateau du Heysel, whose services do not start running before 10 am for the most part, whereas our hypothesis authorises a departure between 8 am and 9 am, with an arrival at 10 am at the latest. While they are comparable overall, Saint-Luc hospital was preferred above Érasme given its slightly bigger size: 480 000 consultations in 2014 versus 350-400 000 for Érasme, with a higher number of beds and staff as well [Cliniques universitaires Saint-Luc, 2014; Université Libre de Bruxelles, 2017].

9. Present in the sectors located 10 minutes away on foot at most (surface mainly included at less than 530 m from the centroid targeted by the measurement).

10. 39,4 minutes when the destinations are not filtered.

11. The standard deviation is 8 minutes, but reaches 12,2 minutes when it is calculated directly for all connections, which testifies to greater variability at this level and shows that the network is organised so that it favours access to the main poles of activity.

12. Furthermore, the range of the values for travel time as well as their geography remain identical overall when the destinations are not filtered.

13. The timetables – at least those of STIB – are adapted regularly to correspond to the actual situation. Cf. methodology.

14. Two comments:

1. This measurement also includes public transport congestion. We may nevertheless assume that this effect is marginal with respect to that of car congestion, in addition to being related to the irregularity of services it causes.
2. The application of new profiles of travel time also has the effect of modifying the conditions for connections, which are unrelated to congestion. These modifications may however cause improvements and deteriorations, and here we assume that the differences are balanced overall.

15. Apart from exceptional circumstances which could have an impact on bus and tram circulation (works, accident, etc.).

16. With respect to STIB, approximately 70 % of the total distance of the different tram lines is protected from car traffic, compared to only 20 % for buses (Lebrun et al., 2012).

17. The STIB tram network is the result of a long historical heritage. Unlike many other European cities, Brussels has never dismantled its network totally, probably thanks to Expo 58, which was an occasion to renovate it [Hubert, 2008].

ABSTRACTS

With an approach based on the modelling of travel time in the Brussels Region, this article examines the accessibility by public transport of a selection of poles of activity in the Region from different neighbourhoods. Measurements of travel time were thus carried out during the morning rush hour on a weekday, taking all operators into account. The analyses highlight a strong intraregional heterogeneity subject to radial and concentric logic, in particular in relation to transport demand. The significant current and potential contribution of operators other than STIB is also revealed. They also show that close to 30 % of the population of Brussels lives in neighbourhoods with poor accessibility due to location, which raises the question as to an objective aimed at making accessibility more uniform from this point of view. With respect to the factors which determine accessibility by public transport, it appears in particular that car traffic still has a heavy impact on travel time, increasing it by 25 % on average, despite the policies in recent years aimed at protecting or separating public transport from car traffic.

Par une approche s'appuyant sur la modélisation des temps de déplacements dans la Région bruxelloise, cet article entend discuter l'accessibilité en transport public d'une sélection de pôles d'activité de la Région au départ des différents quartiers. Des mesures de temps de déplacements ont pour cela été réalisées à l'heure de pointe matinale d'un jour ouvrable, en tenant compte de l'ensemble des opérateurs. Les analyses mettent en évidence une forte hétérogénéité intrarégionale, subordonnée à des logiques radiales et concentriques, notamment en lien avec la demande de transport. La contribution importante, actuelle et potentielle, des opérateurs autres que la STIB est également révélée. Elles montrent aussi que près de 30 % de la population bruxelloise réside actuellement au sein de quartiers présentant un déficit d'accessibilité compte tenu de sa localisation, ce qui pose la question d'un objectif visant à rendre l'accessibilité plus uniforme de ce point de vue. Concernant les déterminants de l'accessibilité en transport public, il apparaît notamment que le trafic automobile pèse encore lourdement sur les temps de parcours, les allongeant en moyenne de 25 %, en dépit des politiques menées ces dernières années et visant à protéger ou séparer les transports publics du trafic automobile.

Via een benadering die gebaseerd is op een modelvorming voor de verplaatsingstijden in het Brussels Gewest, strekt dit artikel ertoe de bereikbaarheid met het openbaar vervoer van een selectie activiteitenpolen van het Gewest vanuit de verschillende wijken te bespreken. Daartoe werden verplaatsingstijden gemeten tijdens de ochtendspits op een werkdag, rekening houdend met het aanbod van alle vervoersoperatoren. De analyses wijzen op een grote heterogeniteit binnen het Gewest, die het gevolg is van een radiale en concentrische logica, en onder meer gelinkt is aan de vraag naar vervoer. Ook de huidige en potentiële grote bijdrage van de andere operatoren dan de MIVB komt daaruit naar voren. De analyses tonen ook aan dat bijna 30 % van de Brusselse bevolking thans woont in wijken die door hun ligging minder goede verbindingen met de activiteitenpolen hebben. Dat doet de vraag rijzen of de bereikbaarheid van die polen niet eenvormiger moet worden. Wat de doorslaggevende factoren voor de bereikbaarheid met het openbaar vervoer betreft, blijkt onder meer dat het autoverkeer nog steeds een grote invloed op de reistijden heeft en ze gemiddeld met 25 % verlengt, ondanks het beleid van de laatste jaren om het openbaar vervoer te beschermen tegen of te scheiden van het autoverkeer.

INDEX

Keywords: mobility, public transport, regional policy, territorial development, urban planning
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