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## Introduction

At the beginning of the nineteenth century, in the region that was to become Belgium in 1830, nearly all households lived near the place they worked. A century later, decentralized living and working had turned commuting into "a social phenomenon of primary importance" that, according to Ernest Mahaim, could no longer be ignored in Belgium.[1] The industrial and commercial census of 1910 confirmed his statement: for the first time the Belgian government ordered the collection of commuting data for *all* 2,629 municipalities. Based on this data, it was to be concluded that 44.0% of all workers and clerks commuted.[2] The replacement of agricultural by industrial labour markets drove the nineteenth-century increase in labour mobility, but commuting as a specific kind of labour mobility needed the Belgian railway policy geared at institutionalizing decentralized living and working in order to blossom.[3]

Indeed, during the nineteenth century mechanized production and expanding trade networks undermined rural labour markets thereby accelerating the pace of residential migration as a century-old mechanism of rural households to deal with an increased pressure on their livelihoods.[4] The mere scope of these urban oriented migration flows resulted in an explosive growth of cities whereby overcrowding, epidemics and the dire living conditions of the labour force triggered social unrest throughout the Western world.[5] To circumvent this unwanted spatial outcome of economic growth, the Belgian government decided to mobilize the "modern technology *par excellence*" to deal with the problem of rural outmigration.[6] By 1910, the Belgian railway policies had established a rural-urban continuum whereby the mobility opportunities embedded in the railway network gave rural dwellers access to urban and industrial jobs whilst allowing them to live in their ancestral villages.[7] The possibility to commute on a nationwide scale was at that moment unique within Western Europe.[8] To be

[1] Mahaim, 1910: vii
[2] Industrial census 1910: vol 8, 7; LokStat
[3] Vandervelde, 1903
[4] Kok, 1999: 89
[5] Leif, 2013: 321-327; Greefs and Winter, 2020: 79
[6] De Block and Polasky, 2011: 313
[7] Polasky, 2001; De Block and Polasky, 2011; De Block, 2014
[8] Mahaim, 1910: ix)

sure, inhabitants of Paris, London, Berlin or Cape Town were familiar with commuting, but the spatial distribution of the industrial labour force was predominantly limited to the boundaries of the city and its suburbs.[9] Like the Belgian politicians, the American government practised a policy of curbing rural outmigration; yet, they used the road and not the railway network to stimulate mobility flows between the countryside and the new labour markets.[10]

Interestingly, this intertwining of transport policies, mobility flows and urbanization dynamics as common practice at the turn of the twentieth century has so far yielded little historical interest. Transport history and history of technology, mobility and migration history, urban and planning history and historical geography all touch upon transport infrastructure, mobility behaviour and location dynamics, but their interrelatedness escapes attention.[11] This paper aims to address that lacuna. It does so by first inquiring how the Belgian government wanted to steer the mobility flows of wage workers by retracing the spatial models that were consciously embedded in the sociotechnical produced railway network. This approach of technology as produced by its social context refutes the idea that transport infrastructures are neutral or technologically determined objects, but considers them to be the joint outcome of technical knowledge, economic ambitions and societal ideologies.[12] To retrace these spatial models, the usefulness of connectivity as analytical tool is explored: first by defining it and then by applying it to the Belgian railway network. Subsequently, I ask myself if the mobility flows needed to establish a rural-urban continuum according to the transport policies, corresponded with the actual commuting flows, and hence location preferences, of peasant households between 1880 and 1910.

## Transport networks as engineering tools

### *Transport policies to modernise society*

Technological networks have an impact on the places "where people live, work, and spend their leisure time".[13] To understand this relationship, knowledge of the spatial models incorporated in the design as well as the organisation of transport networks is needed. Within these spatial models, the friction of distance is to overcome either through connectivity based on proximity or through the relational connectivity of a network. For example, the gravity model gives centre stage to radial-concentric circles with proximity as key variable in core-

[9] Cappuzo, 2018; Pirie, 1987
[10] Weber, 2005: 723-725
[11] Pooley, 2017; Moraglio, 2017
[12] Vanoutrive, De Block and Van Damme, 2018
[13] Van der Vleuten, 2004: 195

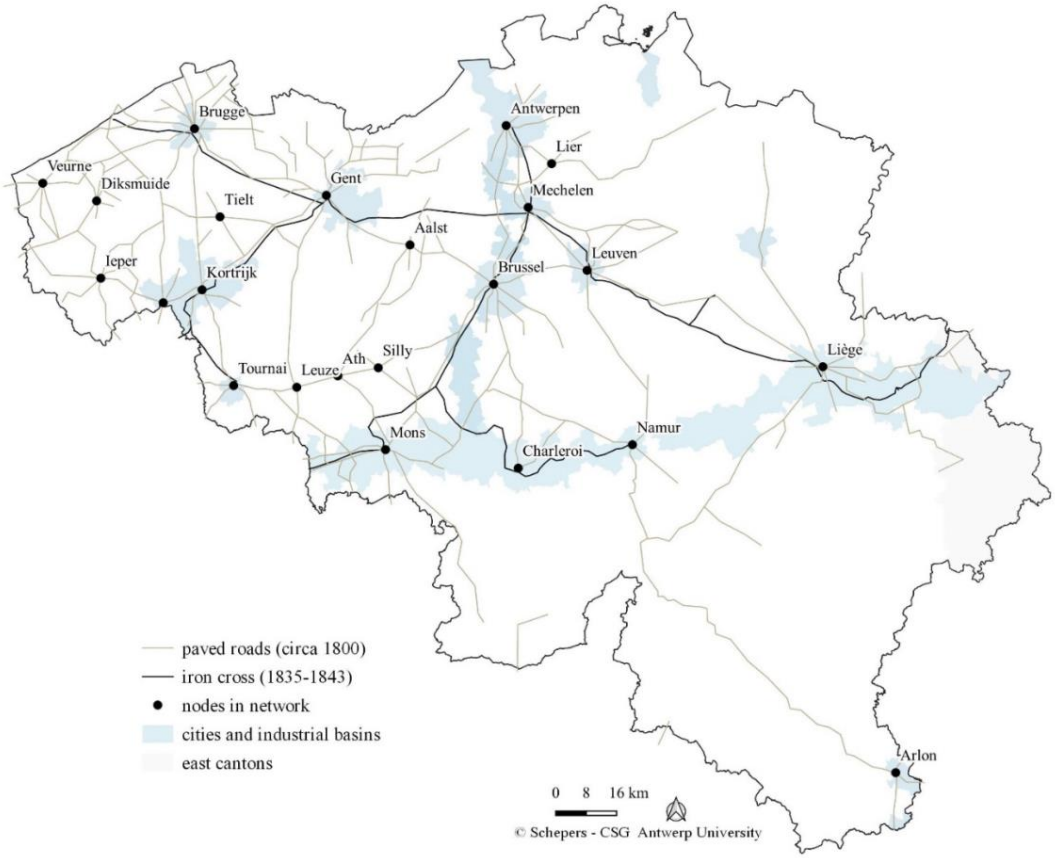
periphery relations. Distance in this spatial model follows the Euclidian definition whereby the connectivity between places is measured in absolute units. In case of a network model, the presence - or absence - of sociotechnical produced transport infrastructure defines the connectivity between places as it enhances - or restricts - the movement of goods and people between those places. This relational connectivity created by the network is malleable on the level of the physical design as well as its organisation. In the physical lay-out politicians and engineers decide which places will be connected whereas the organization of the network regulates the access to the transport infrastructure. Obviously, regulations are much easier to adapt to changing circumstances. Nevertheless, technical adaptations of the infrastructure that has materialized in the landscape still allows the adaptation of the transport capacity.

Research based on proximity is more inclined to conceive places as static entities whereas the relational lens of the network stimulates dynamic thinking.[14] Indeed, the distance that can be bridged by walking is much more fixed than the time-space compressions that can be achieved through the development of technological devices. As a result, transport networks are conceived as social engineering tools that can mould society by determining the relational connectivity between places and hence establish desired flows of goods and people so that the intended spatial transformation results from it.[15] Moreover, the expansion of a transport network multiplies its overall connectivity and as such strengthens the potential to steer spatial transformations.

Although in contemporary society connectivity is seen as a natural characteristic of transport networks, it needed the rise of the nation state and the engineer as technocrat to surmount other customary practices like the planting of trees in the middle of sandy roads.[16] It was only from the middle of the eighteenth century onwards that the use of transport infrastructure as national engineering tool gained prominence.[17] **Map 1** illustrates this. In general, paved roads were private initiatives that enhanced local interests. First and far most, as can be deduced from the fanning-out pattern of paved roads around cities like Ypres, Ghent and Bruges, this meant the strengthening of core-periphery relations between the city and its hinterland. Yet, a novelty introduced by the Austrian Habsburgs made it possible to relate these local interests to national concerns: by making a concession obligatory for the construction of a paved road, the central government could control the trajectory and hence

[14] Loots and Van Hove, 1994: 211-213
[15] Latour, 1996: 32-33
[16] Schepers, 2019: 11-34
[17] Dejongh and Segers, 2001: 171-194, 190-193; Schepers, 2019

the connectivity of the paved road network.[18] This was in particular of interest when corridors between cities, like Leuven-Namur or Brussels-Charleroi, were created.




**Map 1**: Connectivity based on a relational network or proximity.[19]

The central planning of the so-called iron cross between 1830 and 1837 supported by the Belgian government, meant a major breakthrough in the use of transport networks as engineering tools.[20] In contrast with England or France, where the railway adventure was initiated by local and private initiatives, "the comprehensive plan of the Belgian engineers" to create "a radical, top-down, territory-covering instrument" "to order, equip, and manage the territory for the public (or more accurately, the national) good" was exceptional, just as its public funding was.[21] Railway corridors connected the upcoming industrial centres (Ghent, Mons-Charleroi axis, Liège-Verviers axis) with the port of Antwerp and the capital of

[18] Hanegreefs, 1980: 29-30
[19] Buyst et al., 2004: 189; De Block, 2011: 705
[20] De Block, 2011: 703-732
[21] De Block, 2011: 704

Brussels whilst at the same time it facilitated the connectivity with its neighbours England, France and Germany. Next to bolstering the nation-state, this design was geared at stimulating economic growth. Not only was the period of eight years (1835-1843) in which the iron cross materialized in the landscape astonishing short, especially since the railway technology had just seen the light of day, the road- and waterways were also planned as feeder lines of the railway network in order to stimulate its transport capacity.[22]

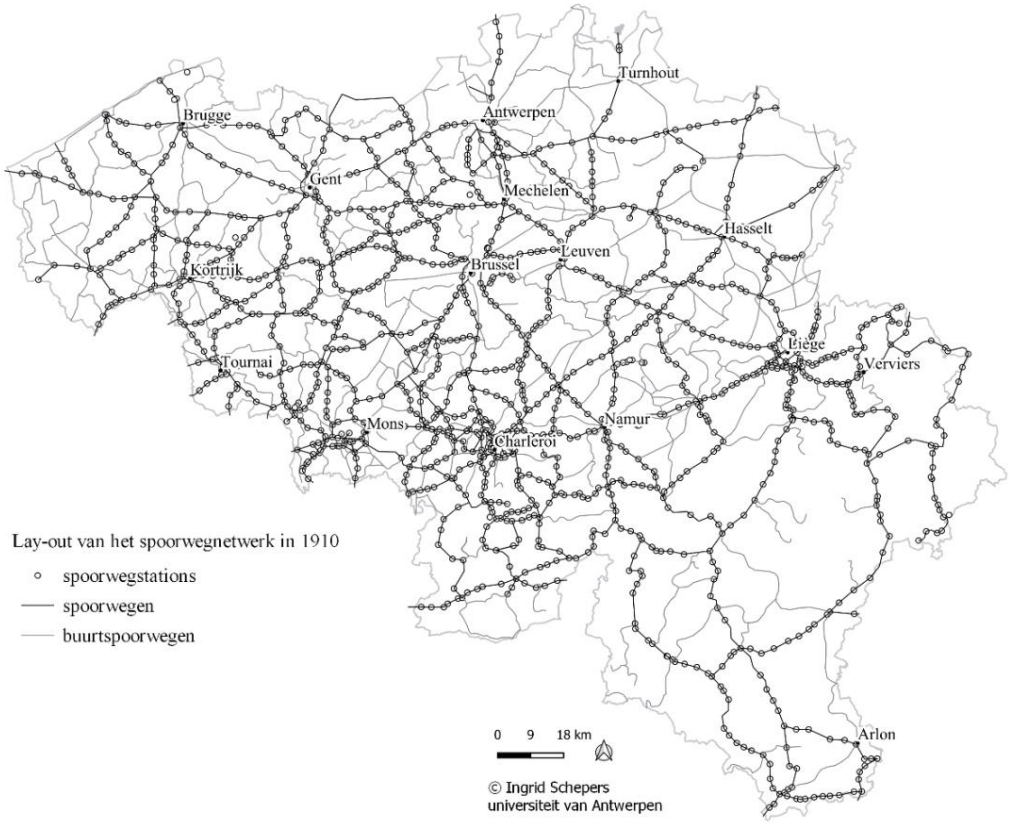
*Transport policies to steer labour mobility*

The iron cross proved to be a successful tool in fostering economic growth. While 'steam' meant energy, 'steel' meant construction material for machines and 'railways' meant the traffic of goods, market exchange became the core mechanism to boost the productivity of these three factors. Simultaneously, the trading networks, materialized in the landscape by the transport infrastructure, brought an industrial based market competition to the heart of rural labour markets, thereby disintegrating the livelihoods of peasant households on a structural basis.[23] As the railway network did not support commuting for these households prior to 1870, the economic upheaval strengthened the dynamic of migration flows towards the industrial and urban labour markets, resulting in an accelerated growth of cities with the depopulation of rural villages as its complement.[24] To curb this unforeseen and unwanted urbanisation process, a new phase of social engineering took off. From 1869 onwards, the railway network was deployed as explicit spatial tool to steer the labour mobility of the rural dwellers so that they would stay in their villages while working in the developing industrial and urban labour sites. In order to make this rural-urban continuum a reality, a national labour market needed to be established by improving the connectivity of the existing railway network through its physical design as well as its organisation.[25]

Although the railway infrastructure covered large parts of the nation in 1870, not all regions were unlocked, nor was the density equally spread.[26] In the countryside in particular the distance to the nearest railway station could be substantial. Therefore, light railways that meandered through the countryside were added to the railway network. They were called light railways because their construction was cheaper and the materials used for the rails and

[22] Van der Herten, 2004: 451
[23] Vandervelde, 1903
[24] De Block and Polasky, 2011: 312-328, 320-321
[25] Van der Herten, 2004: 343-349; Schepers et al., 2020
[26] De Block and Polaksy, 2011: 320-322

transport vehicles were literally lighter.[27] They were explicitly conceived as feeder lines: not travel speed, but collecting as many people and goods as possible was the goal. Similar, instead of creating a network, they "were destined to remain scattered between the meshes of the railway network".[28] As such, these feeder lines added a new layer of relational connectivity to the transport infrastructure in which the network itself took centre stage as the feeder lines joined the main railway lines through the station, not the city.[29] The result of this transport policy is visible in **map 2**. In 1910, the lay-out of the railway network was indeed dense enough to "root workers in their own homes in countryside villages" whilst giving them access to the new labour markets.[30] In addition, the numerous stations made the railway network highly accessible for rural households.




**Map 2**: The lay-out of the railway and light railway network in 1910

[27] Van der Herten, 2004: 378
[28] Pauly, 1936: 6-8
[29] De Block and Polasky, 2011: 318, 321-322
[30] De Block and Polasky, 2011: 320-321

Yet, cheap railway subscriptions for wage workers were a *conditio sine qua non* for peasant households to effectively use the railway network. A ministerial decree introduced these cheap worker's fares in 1869.[31] Even though the tariffs varied in line with the distance travelled, the price set by the Belgian government made it for workers more beneficial to maintain family life in the countryside than renting an accommodation near the job.[32] Each time the formula of the subscription was modified, the mobility opportunities offered by these tickets increased. In 1869, the only formula available was a subscription for six round trips a week on special workmen's trains with a maximum distance of 35 kilometres. In 1896, seven different categories existed, allowing daily and weekly travel in various combinations over a maximum distance of 100 kilometres, except for two categories: labourers who just needed a one-way displacement for their daily journey to work (and returned with another mode of transport) could not travel more than 20 kilometres while workers who needed only one round trip a week could travel as far as they wanted.[33]

In order to implement the cheap railway subscriptions on a national scale, the Belgian government had to exploit the entire railway network. In 1869, this was not the case. As the construction of railways required huge amounts of money, the Belgian government had decided to rely on private capital and had granted private concessions to expand the connectivity of the iron cross.[34] The downside of this transport policy manifested itself during the 1860s when substantive railway corridors were created by the fusions of private companies. Those railway companies no longer added to the profitability of the state railways, but instead became severe competitors. This development of events encouraged the Belgian government to take back control over the national network by buying back private concessions from 1870 onwards.

**Aligning top-down transport policies and bottom-up uses of transport technologies**

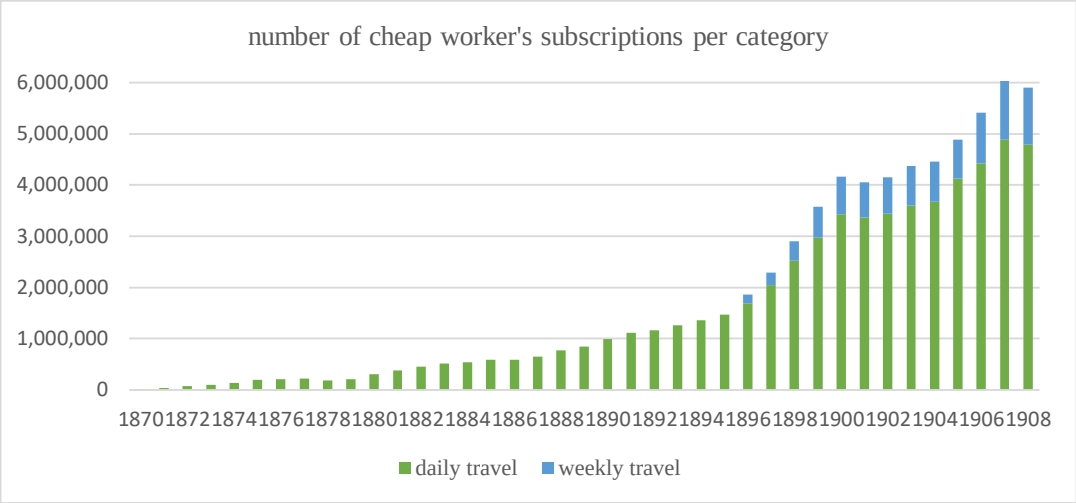
The new railway policies from 1870s onwards wanted to remedy the unwanted growth of cities, being the unforeseen consequence of a successful deployment of the railway network as engineering tool to foster economic growth. For this reason, the state unlocked the countryside by stimulating the construction of light railways and made commuting a viable alternative for peasant households as to limit migration. The political claim that cheap

[31] Mahaim, 1910: 10
[32] Mahaim, 1910: 7
[33] Mahaim, 1906: 537-538
[34] Van der Herten, 2004: 378-343

worker's subscriptions would benefit the labourers advocated this policy: it would allow peasant households to combine the higher wages of the industrial labour markets with a piece of land in the village for growing vegetables, even keeping some small livestock.[35] Still, till 1896 the connectivity embedded in the formula of the weekly subscriptions excluded peasant households in remote places. The Belgian government solved this inequality by allowing one round trip a week over an unlimited distance. With this regulation, the friction of distance was levelled out thereby turning a regional labour market into a national one. Literature linked the substantial growth in labour mobility to this new formula due to the coincidence of these two events in 1896.[36] The argument is guided by the idea of technological efficiency and economic gain: because long-travel distance was made available, peasant households would automatically incorporate this mobility opportunity in their livelihoods in accordance with the political claim that commuting made it possible to combine higher industrial wages with a plot of land providing food security.

**Graph 1** questions the argument of technological efficiency because the number of subscriptions issued for daily travel by far exceeds the number for weekly travel. This implies that weekly travel obviously attributed to the overall increase in labour mobility without however being responsible for the sudden growth in the use of cheap worker's subscriptions. Instead, the statement of Ernest Mahaim that "it is a feature of modern industry that labour is becoming more mobile" has more explanatory value since the increase concurred with the start of the second industrial revolution in 1896.[37] This period had been preceded by a severe agricultural crisis caused by the massive import of grains and other food products in Western Europe. As a result, prices for rural products plummeted on the urban trade markets causing a situation in which "the survival of Belgian agriculture itself was endangered".[38] Indeed, although industrial employment steadily grew throughout the nineteenth century, it was not until the start of the twentieth century that the agricultural sector had lost its position as main employer of the Belgian households.[39] This structural change of the labour markets urged ever more peasant households to adapt their livelihoods in tune with an industrialising world that had made trade the core asset of a modern economy.

[35] De Block and Polasky, 2011: 320
[36] Weber, 2009: 135
[37] Mahaim, 1906: 536
[38] Van Molle, 1989: 25
[39] Schepers, 2021: 11-12



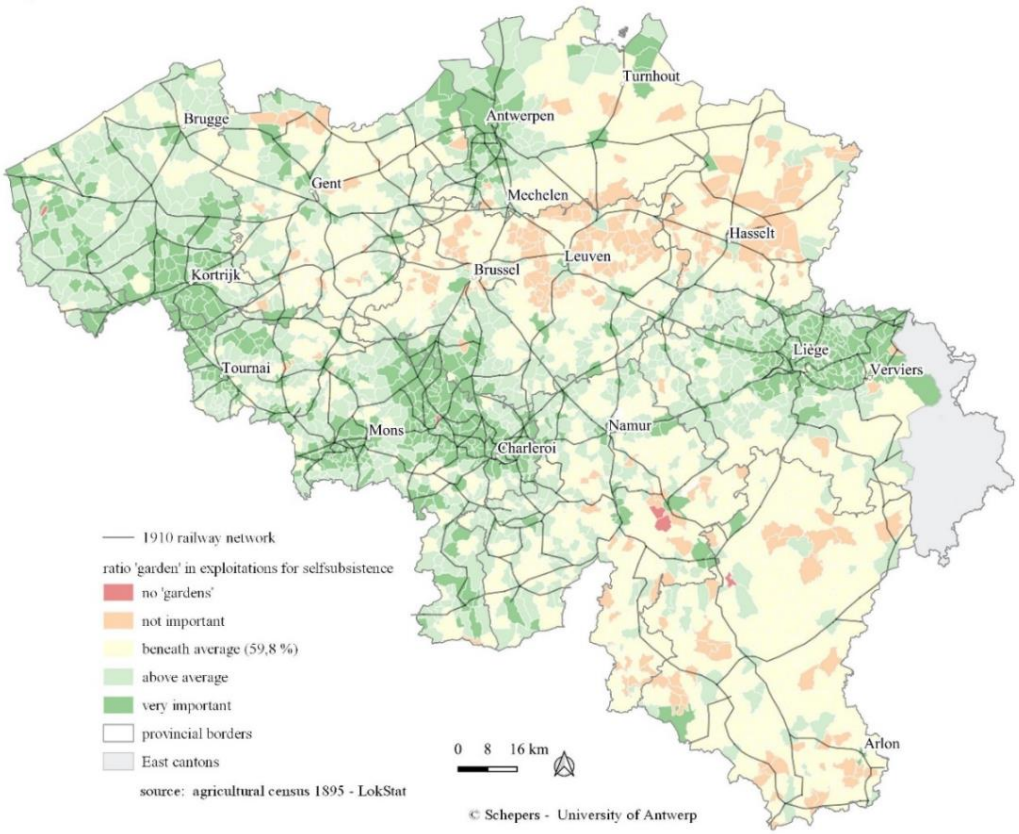

**Graph 1:** Annual distribution of cheap worker's subscriptions per daily or weekly travel.[40]

The idea that earning a living is more important in understanding labour mobility dynamics than overcoming the friction of distance, seems to substantiate the political claim that commuting allowed to combine labour and land: i.e. to earn higher wages in the industrial and urban labour markets while keeping access to a plot of land to grow vegetables in the countryside. As **map 3** exposes, this claim likewise requires further investigation. According to contemporary sources, around two hectares of land yielded enough for a peasant household to be self-sufficient.[41] Smaller plots of land made peasant households dependent on additional incomes. Consequently, this made them ideal candidates to commute between the countryside and the city. As luck has it, the gardens of industrial wage workers were by accident noted down in the agricultural census of 1895.[42] In order to draw the map, gardens were defined as agricultural exploitations being smaller than 0.5 hectares while exploitations geared at self-sufficiency without producing for markets on a structural basis were limited to 2 hectares.

The geographical distribution of these gardens within the total amount of small-scale exploitations renders some interesting results. First, a general pattern can be discerned that locate the gardens near cities and industrial basins (see map 1) with Ghent and especially Brussels as remarkable exceptions. Second, as most of the scattered dark green spots are situated on or near a railway line it can be concluded that the railway network had an additional role in ordering the location of wage worker's gardens. Crucially, these data were recorded in 1895, thus *prior* to the second industrial revolution and the increase in cheap

[40] Mahaim, 1910: 35-36
[41] Laveleye, 1878: lxxxv; Vliebergh and Ulens, 1921:130
[42] Vandervelde, 1903: 178

worker's subscriptions in 1896. Almost automatically this raises a question about the added value of commuting, in particular long-distance commuting, for peasant households in the countryside if they could combine labour and land in places near or with easy access to the industrial and urban labour markets.




**Map 3**: The ratio of gardens in agricultural exploitations up to 2 hectares in 1895[43]

**Restricting labour mobility in a rural-urban continuum**

Neither network technologies, nor societies are static phenomena.[44] Instead, they continuously reshape each other so that the desired distribution of human activities, as well as the mobility flows it originates, changes in accordance with shifting societal ideologies. Even within the same societal ideology, like the establishment of a rural-urban continuum, transport policies geared at steering mobility behaviour were prone to alteration. The timetables of the railway network testify to this.[45] Between 1891 and 1909, when more and more households heeded the

[43] Agricultural census of 1895
[44] Van der Vleuten, 2004: 197
[45] timetables 1891, 1902, 1909

Belgian government's call to commute, the prohibitions regulating the mobility of wage workers increased in number as well as in geographical scope. Obviously, this transport policy reduced the connectivity of the railway network for commuters. Yet, this loss was not reflected in the annual distribution of the cheap worker's subscriptions (see graph 1).

| | time of restriction | number of trains |
|---|---|---|
| 1891 (July-September) | | |
| morning | 4:20 or 6:05 | 1 |
| evening | 17:08 or 18:50 | 1 |
| | | total: 2 |
| 1902 (January-April) | first and last train with restriction | |
| morning | 4:52 and 8:06 | 15 |
| noon | 12:11 and 15:45 | 6 |
| evening | 16:38 and 19:54 | 19 |
| | | total: 40 |
| 1909 (July-September) | first and last train with restriction | |
| morning | 3:59 and 9:06 | 43 |
| noon | 10:10 and 15:49 | 12 |
| evening | 16:15 and 20:25 | 69 |
| | | total: 105 |

**Table 1**: The growth in restrictions for users of a cheap railway subscription.

The general regulations stipulated that all international trains were *de facto* forbidden for labourers possessing a cheap worker's subscription or working abroad. With regard to the national mobility flows, every restriction was linked to a particular train riding at a specified time. It is clear from **table 1** that the amount of restrictions grew substantially between 1891 and 1909 whereby more regulations were formulated for trains riding in the evening than during the morning. Likewise, the time span that the prohibitions encompassed extended through time until it covered the whole day in 1909. In 1891, the only regulations mentioned in the timetable were issued by a private railway company. It concerned two workmen's trains: one bringing commuters from Waver to Charleroi in the morning and one riding in the opposite direction in the evening. This complied with the directives of the ministerial decree that introduced the cheap worker's subscriptions in 8 September 1869.[46] The table shows two

[46] Mahaim, 1910: 9

times of departure in the morning and in the evening because on Mondays and the day after a public holiday, the departure time in Waver was scheduled later then on the other weekdays. The reverse was true for the evening train when departure in Charleroi was earlier on Saturdays and the day before a public holiday in regard to the other weekdays. In the first decade of the twentieth century the transport policies of the Belgian government had changed. In addition to the workmen's trains of a few private companies whose lines the Belgian government still had to repurchase, more and more regulations were activated to steer the mobility of commuters who could not afford to pay the full price of a railway ticket.

To be sure, the railway administration also regulated the mobility of other passengers, like those with a general subscription or a retour ticket, yet never as detailed related to the cheap worker's subscriptions. For example in 1902, wage workers who had Brussels South as their destination were not allowed to take the train leaving Ruisbroek station at 6:05 pm, unless it was a Sunday, a Monday or the first of April. Yet, this disturbed their mobility only slightly as they could take the train that departed in Ruisbroek station at 6:12 pm. At the other end of the spectrum were prohibitions that presented a severe nuisance for wage workers, even to the extent that the harshness of it was debated in the parliament.[47] On the 5th of December 1905, M. Van Langendonck was just one of the socialist representatives that exposed the difficulties timetables could have in store for the labour force. Though four trains left the station of Leuven every morning with Brussels as destination, only the train of 4:52 am brought wage labourers on time at their factories or construction sites. As they were not allowed to get off at Brussels North, these commuters were obliged to walk from the station of Schaarbeek to their work, an obligation that prolonged their displacement up to 45 minutes. Still, they were the lucky ones: taking any other train that was accessible with a cheap worker's subscription meant being late for work and as such losing a day income. The timetable of 1909 reveals that this situation had not been solved by new transport regulations despite the parliamentary debate. Furthermore, the case at hand concerned a direct connection between two important stations, leaving aside the challenge of travelling from over a trajectory that required a switch of trains. As such, this 'mobility friction' makes it even more pertinent to ask why peasant households preferred to live in the countryside.

[47] *Annales parlementaires*, 5 december 1905

## Conclusion

Although the intertwining of transport policies, mobility flows and urbanization patterns was a common practice at the turn of the twentieth century, historical research on this theme is lagging behind. This paper steps in by giving centre stage to the railway network as social engineering tool of the Belgian government during the long nineteenth century. The concept 'connectivity' was used to retrace the spatial models embedded in the physical lay-out of transport infrastructures. Spatial models want to steer the mobility of goods and people in line with societal goals that are defined by politicians and engineers. It highlighted an important feature of social engineering, namely that spatial outcomes and transport policies continuously reshape each other: the explosive growth of cities caused by rural outmigration being a prime example of this dynamic.

It urged the Belgian government to adapt their transport policies from the 1870s onwards. The state railways started to nationalise the railway network by repurchasing previously granted private railway concessions. They expanded the railway's geographical reach by adding light railways to it to physically unlock the countryside and they made the labour force mobile by introducing cheap railway subscriptions so that wage workers could afford the train as commuter vehicle on a daily or weekly basis. Placing the actual commuter flows next to the political desired ones exposed that the structural shift in labour markets due to the industrialisation of society had a much stronger impact on commuter behaviour than the mobility opportunities offered by transport policies. The finding of the 'mobility friction' caused by transport policies during the second industrial revolution confirmed this: although the relational connectivity of the railway network for wage workers was severely reduced, the actual commuter flows increased. As such, the preference of peasant households to stay in the countryside, thereby influencing urbanisation dynamics, is facilitated but not determined by the technological efficiency of transport policies.

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