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Thesis title:
Towards a modal shift in Brussels?

An elaboration on the 2010 IRIS II regional mobility plan

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Summary

In 2010, Brussels' mobility situation was worrying. Congestion gripped the city and it became known as the 'traffic jam capital'. Previous efforts failed to provide an intelligent and integrated vision that would define the future of mobility in the Belgian capital. Starting in 2010, the IRIS II regional mobility plan vowed to become a vector in transitioning towards a sustainable city. However, various identified influential factors negatively impacted the development of modal alternatives. Consequently, despite the achievement of the desired modal shift, authorities failed to provide a coherent vision for a transition towards a sustainable city. This thesis ,therefore, aims to explain how the factors impacted the implementation of planned ambitions and subsequent achievement of the objective.

The thesis first addresses the risks related to increased congestion and reduced regional accessibility, as such, it provides a background and statement of the problem. After defining the research's relevance and research questions, the research provides an overview of the relevant state of the art theories and concepts to formulate a conceptual framework. The third chapter defines the research design and describes how the survey and secondary data findings were collected, analyzed and used. Based on this, the variables and indicators are operationalized. Next, the fourth chapter presents the research findings for all indicators under each sub-research question. The last chapter provides conclusions for all research questions, as well as some recommendations.

The research finds that despite several cities around the world using this type of planning instrument to facilitate cooperation and ease the development of modal alternatives, the IRIS II plan failed to address reoccurring institutional limitations. As such, a remedy must be found to address the inefficiency of Brussels's mobility policies.

In true Belgian fashion, authorities (the region and municipalities) failed to create a culture of continuous, synergetic cooperation. Inconsistent and improper methodologies affected both the practices of participatory governance and the monitoring and evaluation activities. This caused additional challenges in the implementation of proposed actions. Similarly, the absence of information led to authorities being ill-informed. Therefore, this research stresses the need to address such reoccurring issues to facilitate consistent cooperation and improve the quality of information used in decision-making. Thus, ensuring institutional cooperation is a challenge that still forms a recurrent stumbling block in defining a common development vision for Brussels.

Keywords

Urban mobility, modal shift, Brussels, planning, cooperation

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Abbreviations

BCR	Brussels-Capital Region
M&E	Monitoring and Evaluation
MLP	Multi-Level Perspective
MLP	Multi-Level Perspective
STIB-MIVB	Brussels Intercommunal Transport Company
SNCB/NMBS	National Railway Company of Belgium
OECD	Organisation for Economic Co-operation and Development
WWII	World War II
IRIS I	IRIS I regional mobility plan
IRIS II	IRIS II regional mobility plan
GMC/CRM	Regional Mobility Commission

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Chapter 1: Introduction

1.1 Background of problem

Rapid urbanization presents policymakers with new challenges in creating environmentally friendly and financially sustainable urban transportation systems. Cities need to address urban mobility as a key challenge, in doing so they need to provide sufficient mobility infrastructure for the growing population.

National leaders and local policymakers have historically favored car-oriented urban development. Effectively, the latter half of the 20th century saw many transport engineers, educated in the United States, being brought to Europe to introduce car-oriented developments. Consequently, European cities, which traditionally favored active transportation (pedestrians, cyclists) and a reliance on public transport, introduced multi-lane urban roads cutting into and often destroying the existing urban structure (Knoflacher, 2007). As a result, contemporary urban areas have high rates of personal motorization. Nevertheless, as cities face increased traffic problems, policymakers need to rethink urban transport systems to enhance urban mobility (reduce congestion and pollution). Thus, multiple actors and governance levels must work together to solve these shared issues.

The continued growth of the urban population forces the urban transport system to provide increasingly more infrastructure to accommodate growing rates of motorization. However, increased environmental awareness entails citizens becoming more aware of the negative externalities of motorized transportation. Similarly, businesses pay increased attention to the impacts of road congestion on accessibility and economic vitality (Smart Cities Editorial, 2018). Finally, the provision of infrastructure (i.e. roads and inner-city highways) for motorized transportation is constrained by the urban landscape. Such influences push policymakers to rethink the urban transportation system. Doing so, they are encouraged to take a long-term approach, based on an integrated and holistic outlook (Brilhante and Klaas, 2018).

That being said, the rise of sustainability practices, alongside social, technological and economic transformations, offers opportunities to promote a shift in the mobility market. This entails moving away from car-dominated urban spaces to promote multimodal solutions. Such practices should reconcile social equity, economic growth and environmental preservation with urban development; making cities safe, resilient and inclusive without harming the environment (European Commission, 2019).

Thus, cities are questioning traditional models of growth, appreciating a more integrated, collaborative and proactive involvement in healing societies and ecosystems (Campbell, 1996; Neamţu, 2011; Tsay and Herrmann, 2013). The use of proactive planning instruments, promoting participatory governance, help probe the concerns and expectations of citizens and promote co-creation of fit-for-purpose mobility solutions. Literature suggests ‘the use of a master narratives helps synthesize the development processes and fulfill the functional necessities of the city and serve as a tangible representation of what a community wants for its future (Beauregard, 1989). Unfortunately, powerful elite and stakeholder coalitions often dominate the outcomes, led by self-interested ambitions. Consequently, a lack of citizen support and continued political motivation cause proactive actions to fail and ultimately become redundant.

1.2 Problem statement

The use of master planning narratives in the Brussels Capital Region (hereinafter BCR) emerged around the turn of the millennium. IRIS II's predecessor, the IRIS I regional mobility plan (2000-2010), received a particularly negative assessment. "The evolution of regional mobility in Brussels is very worrying as certain important measures of the IRIS 1 Plan have not been implemented. Nonetheless, mobility needs have increased greatly." Local policymakers argued that "If no action is taken, the traffic situation will increase socio-economic and environmental pressures (Thiry and Bruxelles Mobilité, 2011)." Effectively, the growing number of daily trips and the dominant position of cars in the city threatened the wellbeing of citizens and reduced the city's accessibility.
Despite the efforts of the IRIS 1 plan, car-based transportation remained vital. Many urban destinations were still poorly serviced by public transport. As such, the lack of adequate infrastructure for modal alternatives entailed many households cannot dispose of their car, despite the financial burdens linked to its ownership (Hubert et al., 2016). This caused systematic congestion, with adverse effects on the welfare and effective functioning of the city (World Bank Group, 2017). A prospective study, conducted in preparation of IRIS II, predicted an increase of the number of daily trips would cause increased traffic intensity (growth of 6% between 2001 and 2015) (Thiry and Bruxelles Mobilité, 2011). This study found that car-based transportation accounted for 3/5th of trips, it highlighted the lack of alternatives to enter and travel within the city and predicted reduced regional accessibility. Moreover, it called attention to increased pollution (noise, CO, CO2, NOX, COV, PM10, …) and other risks (accidents, lack of public space) (Thiry and Bruxelles Mobilité, 2011).
The development of an integrated, multimodal transportation system proved to be essential to alleviate system-wide pressures.

In order to address these issues, the 2010 IRIS II regional mobility plan aimed to:

- develop alternative transportation modes,
- improve regional accessibility,
- and improve the quality of life for all inhabitants

(Thiry and Bruxelles Mobilité, 2011).

These aims were translated into seven objectives to be achieved by 2018, however, the research will focus on a single objective, namely:

- To promote a modal shift: developing the modal alternatives;

The objective rendered concrete targets to indicate the growth in popularity of modal alternatives. These targets were made specifically for this objective:

- Reduction by 20% of distance travelled by car between 2001 and 2018;
- Increase modal share of pedestrians to 35% by 2018;
- Increase frequency and usage of public transportation by 2018;
- Increase modal share of bicycles to 20% by 2018.

Despite the continued domination of cars in public spaces in Brussels, the local population has become increasingly aware and concerned by the issues addressed in the selected actions, as reflected by the growing popularity of green parties in the city (Barbé, 2019). Moreover, recent

socio-technological innovations in the field of mobility (i.e. electric bikes, electric scooter) have led to increased attractiveness of such modal alternatives, thus forcing local policymakers to provide more infrastructure to accommodate such growth.
Research into the promotion of a modal shift through the development the modal alternatives will undoubtedly highlight local strengths and weaknesses of Brussel's mobility planning and provide insights regarding issues arising during the planning and development process. In order to achieve the objectives and modal shift targets, regional authorities proposed nine actions. This research will focus on the three most relevant actions in relation to the selected objective:

- Favor active (i.e. walking and cycling) modes of transportation;
- Make public transportation more attractive;
- Rationalize the use of cars.

- *Action 1:* Favor active (i.e. walking and cycling) modes of transportation*;*

An increase in the share of active transport would positively contribute to increasing the quality of life in Brussel, reduce congestion and increase the availability of public spaces. It proposes to provide adequate infrastructure for cyclists and develop pedestrian areas to ensure accessibility. The action aimed to develop strategies to increase the modal share of pedestrians (which already had considerable modal share +/- 32%) and cyclists (modal share of only 2%). Thus, it assumes the provision of infrastructure and financial incentives would increase the predominance of active modes. In effect, it led to the creation of both a pedestrian and a cyclist plan and the development of new cycling lanes and pedestrian areas, as well as new bike parking space. This promoted multimodality and strived to guarantee the infrastructure would be sufficient to accommodate a growing number of pedestrians and cyclists.

- *Action 2:* Make public transportation more attractive*;*

A well-developed and integrated public transportation network should provide a robust alternative to cars to reduce the number of car-based trips. For Brussels, this called for an integrated ticketing system to facilitate transfers between different operators. This action targeted the provision of a reliable and efficient transportation network with increased capacity. It translated into the development of new tram- and bus lines and the renovation of 3 metro stations. Increased frequency led to increased capacity and increased the numbers of yearly trips (Thiry and Bruxelles Mobilité, 2011).

- *Action 4:* Rational use of cars*;*

Rational use of cars aimed to reduce their nuisances. To achieve this, developments were guided by principles of proximity, optimal accessibility and multimodality. It led to the development of carpooling options (i.e. increased carpooling station) and required inter-regional cooperation to induce a modal shift for inbound traffic (63% of incoming traffic is done by car) (Thiry and Bruxelles Mobilité, 2011).

These actions reflected an ambition to promote a modal shift; based on the development of a shared, coherent vision for the provision of infrastructure. However, the achievement of the objective and targets was influenced by several factors, namely; the lack of institutional cooperation, the inconsistent stakeholder and citizen consultation and improper monitoring and evaluation.

- Lack of institutional cooperation;

Brussels functions based on a complex institutional structure. The BCR consists of one regional government tasked with coordinating the 19 municipalities. Despite differences in the political coalitions, region authorities rely on municipalities to implement or enforce specific actions at the local level. However, political coalitions in various municipalities may oppose specific developments (i.e. new bike paths along major axis's). Consequently, the diversity of actors involved in the planning process often becomes a stumbling block for continued institutional cooperation. The lack of institutional cooperation results from municipal and citizen opposition often slowing down developments as a result of insufficient political motivation and self-interested ambitions (Hunkin and Krell, 2019).

- Inconsistent stakeholder and citizen consultations;

Regional authorities vowed the planning process would be participatory and inclusive to address the needs and wishes of citizens. However, both regional and municipal authorities lacked resources, know-how and motivation to enact such promises. Instead, such consultations were rarely enacted at the municipal level. Moreover, regional authorities resorted to simply informing citizens of planned actions. This led to major inconsistencies in the planning process; resulting in frustration and disappointment. The inconsistent stakeholder and citizen consultations led to disappointment, a lack of support and hindered future cooperation.

- Improper monitoring and evaluation;

The lack of properly quantified objectives complicated the monitoring and evaluation of developments. This became increasingly problematic as regional and municipal authorities lacked in resources for proper monitoring and evaluation activities. Thus, it became difficult for officials and organizations to monitor the progress and evaluate the results. As a result of this improper monitoring and evaluation, competent authorities were ill-informed about the effects of implemented actions (Rodrigue, 2019).

1.3 Main research question and sub- research questions

Research Question
The central research question for this study is:

To what extent did the identified influential factors impact the development of modal alternatives, to achieve the modal shift set out by the 2010 Regional Mobility Plan (IRIS II) of the Brussels-Capital Region?

The research will consequently also answer the following questions:

- How did the identified influential factors impact the development of modal alternatives?
- To what extent did the development of modal alternatives generate a modal shift in Brussels?

Variables and sub-variables :

Identified influential factors:

- *lack of institutional cooperation;*
- *Inconsistent stakeholder and citizen consultation;*
- *Improper monitoring and evaluation.*

Development of modal alternatives:

- *Public transport (bus, tram and metro);*
- *Active transportation (walking and cycling);*
- *Private car.*

Targeted modal shift as set out by the IRIS II plan:

- *Reduction of 20% for distance travelled by car between 2001 and 2018;*
- *Increase modal share of pedestrians to 35% by 2018;*
- *Increase frequency and usage of public transportation by 2018;*
- *Increase modal share of bicycles to 20% by 2018.*

1.4 Relevance

Brusselization has become a byword for hazardous urban planning. Historically it hindered the development of urban policies providing an intelligent and integrated vision for Brussels. Recent reforms indicate a change in this trend. The re-evaluation of the city's mobility ambitions provided a seemingly intelligent, ambitious and unified mobility plan. However, the need for voluntary cooperation and the complex process of coordinating public action decreased the potential for success of this strategic planning tool. Moreover, the lack of a proper evaluation regarding the impact of the identified influential factors entailed similar problems may arise in the future. Thus, an evaluation of this planning instrument should provide insights with regards to interdependence and cooperation in the region. Elaborating on their impacts should highlight the region's inefficiencies and address the source of each problem (Rodrigue et al., 2016).

Similarly, the research contributes to the ongoing debate on the influence of various factors on urban mobility planning, highlighting the theoretical relevance (Cré et al., 2016). The European Union and national governments alike show a growing interest in urban mobility planning practices, these findings should provide insights into the aspects that deserve more attention. Moreover, it should provide insights into the shortcomings for the development of an efficient and cost-effective strategy for monitoring and evaluation activities.

Having stated this, the research is limited to a focus on the planning process for the development of mobility infrastructure in the Brussels-capital Region, it therefore provides very Eurocentric insights. Moreover, it should be noted that Belgium, and Brussels in particular, provides a highly complex case-study with context-specific institutional structures. The research acknowledges exogenous factors that influence modal choices (i.e. local climate and topography). However, for this research, they will not be considered. Instead, it will highlight how different identified factors influence the development process, in doing so it will highlight potential relationships between these factors and other variables. Moreover, the study will solely focus on the intra-regional mobility issues addressed by the IRIS II mobility plan (2010 – 2018). It avoids discussing train-based transportation as well as inbound car-traffic. Considerations regarding newly emergent technologies (i.e. electric scooters) will not be accounted as these were not initially considered. The research only intends to study how actors

involved in the planning and implementation process contributed to the identified influential factors and the development of modal alternatives. The total population will therefore be limited (approximately 250 people). Moreover, the sample (approximately 90 respondents) and research duration (approximately two and a half months) will be limited based.

Chapter 2: Literature review/theory

2.1 State of the art of the theories/concepts of the study

2.1.1 Urban mobility

Urban mobility serves as the underlying concept for this research. It is defined as "a social and economic need reliant on investments in urban mobility infrastructure to provide access to opportunities, minimizing social exclusion and improving the quality of life (Cré et al., 2016)." Urban mobility covers individual and collective transportation, justifying the focus of the research. Moreover, the conceptual relevance is related to the topics of developing modal alternatives, mobility infrastructure and it is motivated by social, economic and environmental concerns which need to be addressed through institutional cooperation. As such, urban mobility highlights the focus on accessibility and a holistic planning approach. This requires planners pay attention and optimize the use of space to increase density and foster a sense of place. High-density settlements and mixed-use functions enhance economies of agglomeration and encourage non-motorized mobility (Cré et al., 2016; Gerike and Parkin, 2015).
However, planners face various difficulties in planning urban mobility. As such, the diffusion of the automobile increases the demand for car-oriented transportation infrastructure, despite the limited space. Moreover, the lack of affordable housing in dense, mixed-use neighborhoods pushes people away from central areas, increasing the distance travelled and gives way for congestion. Finally, increased motorization impacts the use of public spaces as it limits the available space for modal alternatives and other street activities (Rodrigue et al., 2016).
Urban mobility furthermore highlights efficient public transportation to reduce systematic congestion. Low frequency induces crowdedness, resulting in discomfort and low ridership, making the service financially unsustainable. Moreover, repairs and maintenance create delays, thus making maintenance a burden which decreases efficient urban mobility. Nonetheless, the maintenance of all transportation infrastructure is vital for the efficient urban mobility and the welfare of cities (Committee of Regions, 2019).

2.1.2 Brussels Regional Mobility Planning and identified factors influencing its development

Prior to the establishment of the BCR in 1989, mobility was a national affair with two separate ministries: public works and road ministry and the transportation ministry**.** This duality reflected the battle between car and other forms of transportation, it furthers proves multimodality was not the norm. The car was king in Belgium and continued to swallow up public space. Post-WWII planners found cars should have access to all parts of the city, leading to an increase in the number of car-lanes and the construction of the inner-city highway (small ring) to accommodate the city's growing population and motorization. Nonetheless, it also gave way for the development of an above and underground public transportation network (Berger, 2018).

1989 paved the way for Brussels to gain autonomy over local mobility matters. As such, the region became responsible for roadworks, public transportation and general mobility management. However, it remained highly interdependent. The federal government continued to manage the use of cars as well as train-based transportation. Regardless, the regional government now had more power in determining their mobility development path (Hubert et al., 2013).
In light of this, the regional bodies conducted studies between 1989 and 1995 in preparation for the implementation of the first strategic mobility plan (IRIS I), launched in 1998. It laid out the foundations for balanced mobility, based on a 'long-term' vision for increased accessibility and sustainable development, as laid out by the Kyoto agreement (Thiry and Bruxelles Mobilité, 2011). However, years after the 2005 horizon, Brussels still regularly scored as the "European traffic jam capital" (Hubert et al., 2013). With this in mind, the IRIS II plan was adopted in 2010 by the BCR. It moved from a single vision of mobility to one of multiple shared mobilities. In doing so, the plan attempted to make way for public and active transportation.

2.1.3 Identified influential factors

International literature on urban mobility planning highlights problems relating to the organization and the capacity of cities to plan urban mobility. It identifies organizational and cooperation issues in developing and implementing planning instruments. It moreover highlights the need to formulate effective policy measures, sustain institutional cooperation, promote stakeholder and citizen consultation and to conduct regular monitoring of the developments. Literature furthermore calls attention to funding and workforce capacity.
Thus, this research aims to shed light on the influence of certain essential conditions (i.e. institutional cooperation, stakeholder and citizen consultation, and monitoring and evaluation). These are essential for the development and implementation of any planning instrument with regards to effective urban mobility planning (Lindenau et al., 2016).

Identified influential factor: lack of institutional cooperation

Democratic decision-making rests on the assumption of institutional cooperation; the sharing of knowledge, resources and powers between all relevant actors. It requires strong leadership to balance the different needs and perspectives, and the enforcement of coordination mechanisms. The aim should be to achieve consistent cooperation based on mutual understanding of the expectations, outputs and objectives.
Institutional cooperation should be effective and efficient. It entails governmental authorities engage relevant stakeholders and institutional actors to gain support and define a common vision based on shared goals and objectives. Moreover, there needs to be agreement on the cooperation structure and hierarchy (Béland and Howlett, 2016). It involves identifying competent partners and stakeholders, agreeing on responsibilities and complying with the legal environment (Cré et al., 2016). Howbeit, a large and complex institutional structure can threaten institutional cooperation, resulting in disagreements and other challenges. This being said, various forms of institutional cooperation need to be differentiated:

- Vertical cooperation
  Based on hierarchical links between different national, regional and local authorities;
- Horizontal cooperation

Does not rely on hierarchical links, the organizations are independent and function autonomously;

- Spatial cooperation
  Refers to cooperation that is needed between local and neighboring authorities, as well as other relevant stakeholders within this area;
- Inter-sectoral cooperation
  Focused on cross-sectoral integration, such as between different sectoral departments under the local authority.

Identified influential factor: Inconsistent stakeholder and citizen consultation

Trust in the political system is fragile and requires citizens to feel engaged. The European Union has introduced various reforms to promote increased transparency; to strengthen democracy, promote institutional cooperation and create channels of dialogue to listen and respond to the wishes of European citizens (European Committee of Regions, 2019). However, increased citizen participation cannot simply be a campaigning tool. Instead, citizens should shape society by becoming part of the political architecture. It requires that they feel engaged in working collectively to improve society and strengthen democratic transparency. Doing so, it improves the quality and sense of ownership over policies.
As cities engage in the development and consequent implementation of strategic planning instruments, the planning process requires cooperation, knowledge exchange and consultations between planners, politicians, institutions, citizens and other relevant actors. In fact, the development of a city's transportation system should be driven by those at the heart of the system, the citizens (Lindenau et al., 2016)
In Brussels, few municipalities systematically organize neighborhood meetings to identify the needs of citizens and improve dialogue. However, since 1994 the regional authorities make use of neighborhood contracts to promote urban revitalization. It places structural participation at the heart of the revitalization; to favor social innovation in a dynamic and sustainable urban environment (City of Brussels, 2020). However, almost three decades of neighborhood contracts have highlighted issues of durability, transversality and representation. Research identifies two necessary conditions for successful stakeholder and citizen consultation:

A. Gaining support and building consultation capacity

To achieve fruitful consultations, citizens need an indication that authorities will commit to the process. Moreover, successful consultations require the setting up of dialogue structures and the development of an internal administrative capacity to process the findings. Finally, it requires sufficient financial resources. These activities should be aimed at conflict mediation to overcome resistance and disagreements, and help authorities to gain support (Patapas, 2014) It should ensure balanced transparency, avoid overpromising, maintaining interests and address challenges of involving a mixed group of citizens.

B. Selecting and applying the right mix of consultation formats

The array of consultation tools, methods and techniques should help activate interest in citizen consultations and promote sustained institutional cooperation. This requires authorities to be clear about how and when suggestions will be integrated into the decision-making process as to maintain transparency and manage expectations. A failure to do so may cause opposition and loss of support. Ultimately, this reflects the growth in popularity of *new public governance* perspectives which find that growing social fragmentation can be addressed by increasing the

number of people, groups and organizations involved in decision-making(Reed et al., 2018). As decisions should be supported by civil society, the process of stakeholder and citizen consultation should be continuously reevaluated to ensure proposed actions are responsive to the needs and wishes of citizens (Patapas, 2014; Reed et al., 2018)

Identified influential factor: improper monitoring and evaluation

Regular monitoring and evaluation (M&E) activities need to be conducted to gather information for the progress and impact of any strategic plan. This helps monitor the efficiency of the planning process and the effect of implemented measures. Thus, M&E strives to optimize the use of resources and provide real evidence (Gühnemann, 2016).
Monitoring refers to systematic and continuous data collection, to gain insights into the state of a policy at any given moment. In relation to the objectives and intended results, the collected information provides necessary considerations for future actions. Similarly, evaluations help assess the final performance, effectiveness and impact of the concerned policy. Thus, M&E are two distinct elements that complement each other and serve as important managerial tools to provides clarity (Gühnemann, 2016).
Monitoring activities should happen regularly. It requires different instruments, methods and techniques to monitor impacts and conduct impact evaluations. However, there is generally no consensus on how it should be done due to the plethora of possible M&E activities. Nonetheless, it involves; clearly defining objectives, defining performance indicators, determining a baseline, predicting the effects of actions, measuring and comparing the change in conditions as well as interpreting and analyzing the findings (Toscano, 2013). As such, during the preparation phase, officials need to be aware of potential problems and challenges. They also need to gather data and establish a baseline against which to compare the expected impacts. This helps to review intermediate outcomes and guide future interventions (Rakić et al., 2014). Finally, it requires a budgeting and a clear legal framework to ensure the process meets the expectations (Kengera, 2018).
This process should be transparent, achieved through the systematic sharing of records and reports. These serve as evidence for the final evaluation and to support future programs advocating for policy change; thus, they should expand on the lessons learned and the recommendations for future policies (Rakić et al., 2014; Scott Toscano, 2013).

2.1.4 Development of Modal alternatives

Urban mobility has significantly evolved under the influence of industrialization but remains a key dynamic of urban life. However, the current modal share distribution poses a challenge to the urban mobility systems which struggles to cope with demands for more transportation infrastructure. This is accentuated by the prediction which argues that by 2050 the distance travelled by citizens will be almost four times more than in the year 2000 (United Nations Human Settlements Programme, 2013).
Contemporary mobility practices may seem convenient in terms of time, cost and comfort but produce several negative externalities (i.e. pollution and congestion). Developing modal alternatives, therefore, proves to be an important factor for the development of sustainable urban mobility (Cré et al., 2016; United Nations Human Settlements Programme, 2013). However, developing modal alternatives relies on the complex interplay between the different levels of influence in society. With regards to this, the Multi-Level Perspective (MLP) is a useful analytical framework for understanding transitions. It identifies three levels within societal change, namely;

- Niches

Where radical innovations emerge;

- The regime

Which is comprised of dominant institutions and technologies;

- The landscape

Representing macro-level trends, contextual drivers and barriers to change (Whitmarsh 2012, p.11)

The framework argues that the main dynamics of change occurs within the regime and niche levels, as a result of their interactions. The niche level is less constrained by dominant institutions, this facilitates experimentation with radical innovations. The regime level experiences incremental change. Vested interests, bureaucracy and other factors influence opportunities for change at the regime level. Finally, the landscape influences the development of change as it is pressured by the innovations at the niche level.

With regards to urban mobility, the MLP-model reflects on interdependencies and the co-evolution of infrastructure, institution, technology and society. It highlights the interaction of factors producing change within the socio-technical system. Moreover, it helps identify policies that stimulate mobility transitions. This helps to identify processes and actors involved in socio-technical transitions and change (Whitmarsh, 2012).

Effectively, the MLP-framework finds niche groups (i.e. environmentally concerned citizens) favor certain modal alternatives (i.e. cycling) and demand policy changes. Regime-level groups (i.e. energy and automotive firms) instead prefer technological innovations (i.e. hybrid cars) (Pastori et al., 2018; Whitmarsh, 2012). All are facilitated, and constrained, by the landscape.

Any modal shift is facilitated by shared mobility solutions, often based on peer-to-peer and business-to-consumer models. However, currently, the fragmented and hostile management of urban mobility does not allow market players to integrate mobility solutions. Thus, system-level collaboration between all stakeholders is needed to support, promote and implement innovative business models. However, the MLP-perspective suggests this is still relatively far from being fully achieved, as the landscape level continues to ignore important feedback. Thus, to help understand how modal alternatives can be developed, it helps to understand what transitions are needed to build support for a shift towards sustainable urban mobility (Pastori et al., 2018).

2.1.5 Modal shift

Throughout history, the development of modal alternatives has resulted in significant modal shifts. Walking was the most common way of getting around until the 1930s and remains an important part of multi-modal mobility until today. However, throughout the 20th century, many major European cities noted a shift towards mass public transport and private automobility, though walking remained the main way of commuting in smaller cities and towns (Marsden et al., 2019). As motorized transportation continued to grow, it created a need build a national road network. Generally, the rise in popularity of cars went hand in hand with a decline in the use of buses, trains and bicycles.

As cities continued to grow, these trends were accentuated. Increased car-ownership encouraged urban sprawl and city centers became almost inaccessible. Thus, active modal alternatives lost to motorized alternatives. These trends led to a downturn in the provision of quality infrastructure for active users. The lack of willingness to integrate other modal options also led to less frequent and affordable public transportation solutions. Ultimately it meant cars had noted a modal shift in their favor. This came at the expense of socially vulnerable citizens

(women, children, elderly and minority groups) which saw diminished access to employment opportunities and services. In fact, the dominance of motorized transportation increased social inequality in urban centers (Cré et al., 2016; Marsden et al., 2019).
The increased popularity was facilitated by the private sector, with the support of governments, which gave way for favorable investments and regulations. Decade long path dependency hampered innovation for other modal alternatives. Moreover, it led to new governance challenges resulting from the negative health and environmental impacts of motorized transportation. Ultimately, by the second half of the 20th century, each modal alternative was treated separately and developed its own institutional structure. Effectively creating modal silos (Marsden et al., 2019).
The growing dependence on motorized transportation continued throughout the 21st century. Public transportation decreased in popularity and became disproportionately used by low-income groups (Marsden et al., 2019). However, the 1992 United Nations *'Rio conference'* led to the development of Agenda 21. It emphasized sustainability and led to the international conference *'Towards Sustainable Transportation'* which argued that 'systems of transportation used in OECD countries are unsustainable.*'* It promoted the integration of *environmentally friendly* modal alternatives; including public transport, walking and cycling. It argued the achievement of a modal shift was essential for the effective functioning of cities. It highlighted the dependence on supportive and nurturing institutional, regulatory and governance structures (Gerike and Parkin, 2015). Unsurprisingly these results were controversial in a car-centered society.

2.2 Conceptual framework

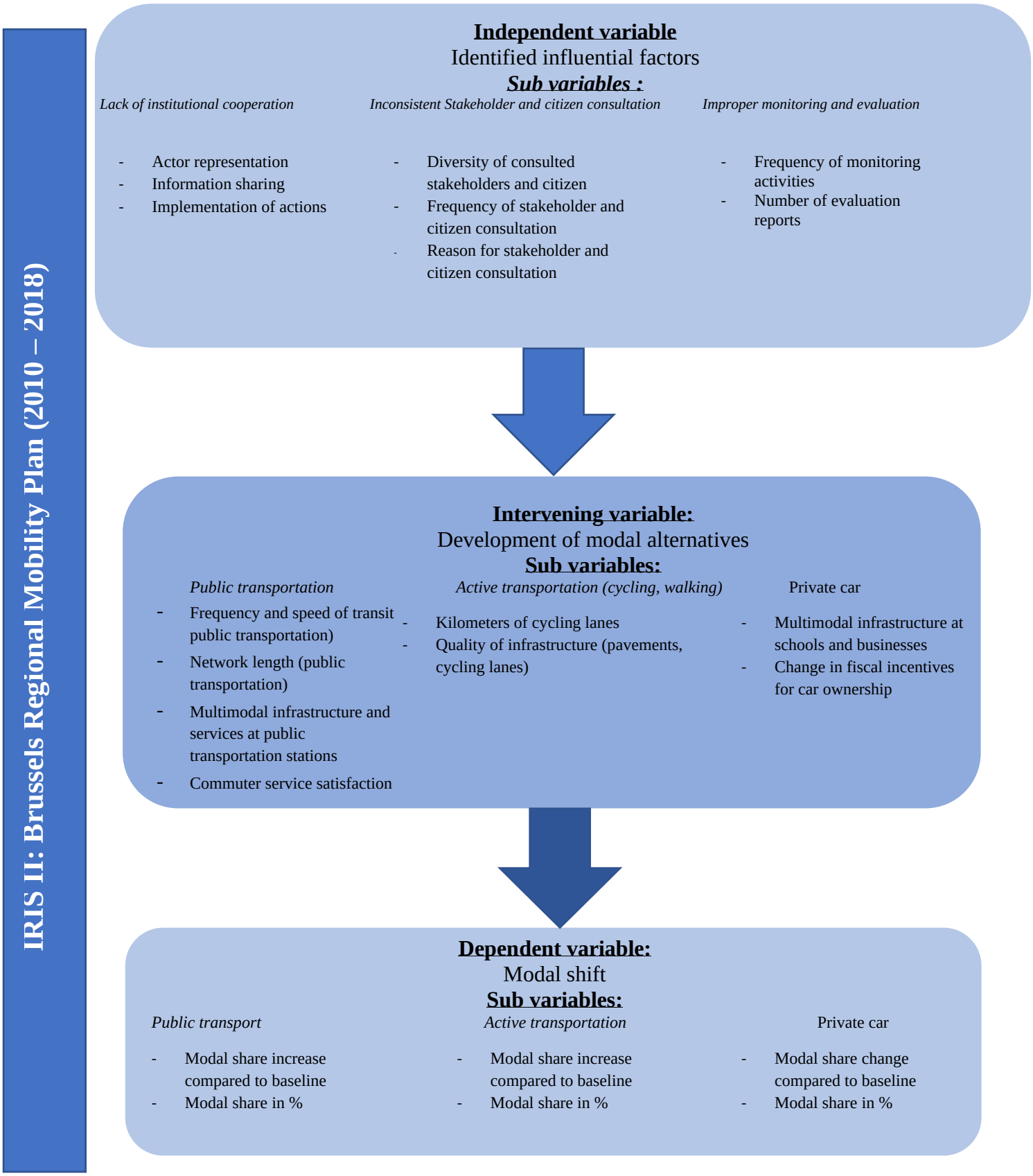
The focus of this study on urban mobility in Brussels was undertaken by the following conceptual framework shown in figure 1, it is comprised of a three-part process: the input (identified influential factors), the process (development modal alternatives) and outcome (modal shift).

- **The input:** is comprised of *lack institutional cooperation, inconsistent stakeholder and citizen consultation* as well as *improper monitoring and evaluation.* The identified influential factors derive from findings shared in contemporary academic literature concerning urban mobility and strategic planning. Based on the new public governance theory the aim is to elaborate on the role of public officials in the face of increased representation, through stakeholder and citizen consultation in planning.

- **The process:** reflects the development of modal alternatives (i.e. public transportation, active transportation and motorized transportation). Based on the MLP, this research aims to articulate whether any societal transitions took place to facilitate the development of modal alternatives. The MLP model reflects the need to gather support across levels, to achieve the development of previously undervalued modal alternatives.

- **The outcome:** this refers to the desired outcome, being a modal shift, as set out by the IRIS II regional mobility plan. The development of modal alternatives aims to increase the frequency and use of public transportation, increase the modal share of cyclists (20% by 2018), decrease the distance travelled by cars (-20%) and increase the share of pedestrians (35% by 2018).

Figure 1 Conceptual Framework



Chapter 3: Research design, methods and limitations

This chapter provides a detailed description of the employed research strategy, process and operationalization. It describes the procedures employed to select a representative sample, as well as the data collection process. Furthermore, it describes the instruments and methods applied to collect and analyze the data. It also provides the definitions of concepts, variables and sub-variables and operationalizes the variables into measurable indicators. Finally, it includes the fieldwork plan and discusses the challenges and limitations.

3.1 Description of the research design and methods

3.1.1 Research type and strategy

This explanatory research uses a case study research strategy to describe how the identified influential factors impacted the development of modal alternatives. Doing so, it identifies the extent to which the development of modal alternatives generated a modal shift in Brussels. The use of a case study, applied to a contemporary, real-life phenomenon contributes to improving the types of solutions used to address similar issues. It does so by providing a detailed and extensive description of the case study (van Thiel 2014, p. 89). As such, the IRIS II plan is somewhat representative of mobility planning practices in European cities and is particularly representative of mobility planning practices in the context of Brussels' urban mobility. Thus, this explanatory research can help establish the extent to which the identified influential factors impact mobility planning practices, within similar contexts.

3.1.2 Data collection instruments

Primary data collection instruments

Semi-structured interview

This research makes use of semi-structured interview structure; with questions based on the operationalization of variables. This is derived from the theoretical framework to gather information on the experiences of those involved in the planning and implementation process. The interview manual (annex 1) provides an overview of the covered topics and guides the interview in a structured manner to guarantee all relevant information is gathered. These findings were consequently cross-referenced with secondary data.

Questionnaires

An online written questionnaire was also used for the primary data collection. Though it was only used for some of the indicators under the intervening variable. When possible, it helped cross-reference the findings. The questionnaire mainly consisted of close-ended questions, though four open-ended questions were used to receive more detailed information (i.e. name of organization) and alternative opinions (i.e. alternative influential factors). The close-ended questions provided qualitative information about the development of modal alternatives. The questionnaire covered the following sub-variables of the intervening variable: public transportation and active transportation. The questionnaire included four control variables to inform on answering patterns and consequently identify and control distorting influences. After a first pilot version, the questionnaire structure and targeted respondents were reviewed. The

difficulty of finding respondents actively involved in IRIS II entailed respondents would not be informed enough about the independent and dependent variable and therefore focused on gathering perspectives on the development of modal alternatives, to diversify the type of respondents. Respondents consist of regional and municipal administrative staff, stakeholders and commuters (annex 2).

Secondary data collection instrument

Desk research

The research made us of pertinent official reports, academic research papers and other data sources (i.e. newspaper articles), as per the research subject (urban mobility and modal shift). It provided valuable insights and information regarding the planning process, registered modal developments and monitored modal shift (van Thiel 2014, p. 103). It moreover contextualized information derived from primary data collection instruments and helped to identify new or contradicting insights. All secondary data came from publicly available online sources.

3.1.3 Unit of analysis

Sample size and selection

The sample size and respondents selection for this study were based on the institutions, organizations and stakeholders involved in developing and implementing the IRIS II plan. The total population for this study is approximated at 250 people, this includes political representatives, relevant administrations, stakeholders and some highly informed citizens. Using a confidence level of 95%, a margin of error of 6.62% and a population proportion of 20% the research strived to gather approximately 90 survey responses (Maple Tech. International, 2019). In the end, a total of 95 responses were gathered.
The selection of respondents, for the interviews, was based on non-probability purposive sampling. All 8 respondents were political and stakeholder representatives (see table 1) involved in the development and/or implementation of the plan. They were selected to answer the semi-structured interview. All participants were contacted by email, with an interview request, using publicly available information.
Based on difficulties in this part of the data collection, due to the retrospective character of the study, questionnaire responses were gathered based on a non-probabilistic snowball sampling. A total of 87 individual questionnaire responses were collected after the questionnaire had been sent by email to all municipalities, relevant regional authorities and stakeholders, as well as a few commuters involved in action groups.
Finally, the selection of officials documents, academic literature as well as newspaper articles was based on a non-random representative selection process. Doing so, only sources suitable for the study were looked into.
Table 1 shows the characteristics of all interview respondents. Annex 2 provides an overview of the questionnaire respondents characteristics.

Table 1 Interview respondents

Respondent	Gender	Participation	Characteristic
R1	Male	Yes	Ex-secretary of state for mobility
R5	Male	Yes	Spokesperson for regional mobility ministry
R6	Male	Yes	Alderman for municipality
R4	Male	Yes	Alderman for municipality
R3	Female	Yes	Spokesperson for regional stakeholder (pro.vélo)
R2	Female	Yes	Alderwoman for municipality
R8	Male	Yes	Mobility Advisor for regional authority and member of regional mobility commission
R7	Male	Yes	Stakeholder (Ouders van Verongelukte Kinderen) representative

N=8

3.1.4 Field work and data collection

The fieldwork took place between the end of June and mid-July. During the first phase interviews and questionnaire participation requests were sent to all potential respondents. Next, the second phase focused on conducting the interviews as well as transcribing them. The third phase focused on contacting referrals to generate questionnaire participants and gaining respondent validation for the interviews.

3.1.5 Validity

"To guarantee sufficient validity, it is crucial to select the right measurement instruments, the right sample and to use measurable indicators."
(van Thiel 2014, p.50)

Internal validity

Internal validity refers to whether the researcher measured the intended effect. It is based on the data collection instruments and proper operationalization of theoretical constructs to prove

the relationship between the independent and dependent variable. The concept of urban mobility was linked to the interventions described in the IRIS II plan. Accordingly, definitions are based on the interventions proposed in the plan. The wealth of collected information determined the value of this study. The researcher diversified the data sources to cross-reference findings, and triangulate when possible. The diversity of research instruments increased the quality and internal validity of the study (van Thiel, 2014).

External validity

External validity refers to the extent to which this study can be generalized across other situations and times. To alleviate some of the shortcomings posed by the small number of units of study (1 case study) triangulation and cross-referencing ensured the data is valid and representative.

3.1.6 Reliability

The reliability of the findings relates to the accuracy and consistency with which the variables are measured, this should ensure the research is replicable. The consistent use of all questions during interviews helped ensure the data was consistent and comparable. The short period also helped avoid interference from due to changes. Moreover, respondent validation helped ensure the quotation used represented their views (Verschuren and Doorewaard 2010, Thiel 2014, p. 53).

3.1.7 Data analysis methods

Interview data was used for all variables and sub-variables. The data was transcribed manually and analyzed using the Atlas.ti software. The researcher used the free code function to create codes based on the indicators. Next, the researcher used the co-occurrence explorer tool to create a cross-tabulation of all codes to show code co-occurrence, using proximity operators. Furthermore, the co-occurrence table highlighted the frequency of co-occurrences, using the c-coefficient to indicate the strength of their relation. Based on these findings, the query tool was used to retrieve quotations associated to selected codes and identify patterns in the combinations. It used operators to define the conditions that must be met to retrieve quotations. Questionnaire data was analyzed using the SPSS statistical software and excel. First respondent characteristics were highlighted using the pivot table tool. Next, a bivariate Pearson correlation analysis and regression analysis were conducted to find the strength of association and determine which variables were most significant towards inducing registered modal shift. However, the findings were insignificant, consequently they were not used to make conclusive statements. Instead, the questionnaire was used to identify trends in the responses, to compare with other findings.
The research also conducted desk research based on content analysis of secondary materials. This was used to cross-reference both qualitative and quantitative findings, thus improving reliability and internal validity of the findings. The research used official documents published by municipal and regional authorities as well as stakeholders. It also used academic literature relating to the concept of urban mobility, as well as local newspaper articles on specific actions.

3.2 Operationalization: variables, indicators

Concept of Urban mobility

Based on an adaptation of the definition proposed by Cré et al. (2016, p.20), this research defines urban mobility as "a social and economic need reliant on investments in urban mobility infrastructure to provide access to opportunities, minimize social exclusion and improve the quality of life." This definition accentuates the relation with accessibility, ensuring that people can reach destinations and meet their needs.

Identified influential factor (Independent variable)

Cré et al. (2016, p.13) provides the basis for the definition of identified influential factors, namely "having been identified as being essential for the development and implementation of any planning instrument with regards to effective urban mobility planning."

Lack of institutional cooperation (Independent sub-variable)

Lack of institutional cooperation is defined based on the adaptation of the definition proposed by Cré et al. (2016, p.10). It is defined as "absence of pragmatic cooperation within and across institutions to develop and implement policies based on shared objectives, knowledge and powers as well as strong leadership and mutual understanding to enforce coordination mechanisms."

Inconsistent stakeholder and citizen consultation (Independent sub-variable)

The proposed definition for inconsistent stakeholder and citizen consultation is based on a combination of definitions used by the European Committee of Regions (2019, p.25) and by Lindenau (2016, p.10): "Increased transparency through increased participation of civil society as a means to strengthen democracy, promote institutional cooperation and create channels of dialogue to listen and respond to the wishes of citizens, and create a sense of policy ownership."

Improper monitoring and evaluation (Independent sub-variable)

The final independent sub-variable is defined as "the systematic and continuous data collection to gain insights into the state of a policy at a given moment (in relation to the objectives and intended results) and entails the collection and analysis of data, knowledge and other evidences obtained through monitoring (Gühnemann, 2016)."

Development of modal alternatives (Intervening variable)

The definition for the development of modal alternatives is an adaptation of Pastori et al. (2018, p.3). It is defined as "system-level collaboration between all stakeholders to implement integrated and innovative business models that accommodate, strengthen and promote modal alternatives."

Public transportation (Intervening sub-variable)

The definition of public transport is derived from the IRIS II plan, namely the use of bus, tram, pre-metro, metro (Thiry and Bruxelles Mobilité, 2011).

Active transportation (Intervening sub-variable)

Similarly, the IRIS II definition of active transportation will be used, it is defined non-motorized transportation options such as walking or cycling (Thiry and Bruxelles Mobilité, 2011).

Private cars (Intervening sub-variable)

The private car sub-variable refers to cars owned by private individuals as well as car sharing options (Thiry and Bruxelles Mobilité, 2011).

Modal shift (Dependent variable)

The modal shift definition is derived from the IRIS II plan "improving the coverage of public transport and improving the active mobility infrastructure in order to change public behavior and reducing the prevalence of car (Thiry and Bruxelles Mobilité, 2011)"

For the sub-variables (Public transportation, active transportation and private cars) the research uses the same definitions as those used for the development of modal alternatives.

Table 2 Operationalization table

Concept	variable	sub-variable	indicator	Data type	Data collection instrument	Data Source
Urban mobility	Identified infuential factors	lack of institutional cooperation	*Actor representation*	Qualitative	Interviews/desk research	Political and stakeholders representatives and official reports
			Information sharing	Qualitative	Interviews/desk research	Political and stakeholders representatives and official reports
			Implementation of actions	Qualitative	Interviews/desk research	Political and stakeholders representatives and official reports
		Inconsistent stakeholder and citizen consultation	*Diversity of consulted stakeholders and citizens*	Qualitative	Interviews/desk research	Political and stakeholders representatives and official reports
			Frequency of stakeholder and citizen consultation	Qualitative	Interviews/desk research	Political and stakeholders representatives and official reports
			Reason for stakeholder and citizen consultation	Qualitative	Interviews/desk research	Political and stakeholders representatives and official reports
		Improper monitoring and evaluation	*Frequency of monitoring activities*	Qualitative	Interviews/desk research	Political and stakeholders representatives and official reports
			Number of evaluation reports	Quantitative	Interviews/desk research	Political and stakeholders representatives and official reports
	Development of modal alternatives	Public transportation	*Frequency and speed of transit*	Quantitative	interviews/desk research	Political and stakeholders representatives and official reports
			Network length (public transportation)	Quantitative & Quantitative	Interviews/questionnaires/desk research	Respondents and official reports
			Multimodal infrastructure and services at public transportation stations	Qualitative	Interviews/desk research	Political and stakeholders representatives and official reports
			Commuter service satisfaction	Quantitative & Quantitative	Interviews/desk research	Political and stakeholders representatives and official reports
		Active transportation (cycling, walking)	*Kilometers of cycling lanes and sidewalks*	Quantitative & Quantitative	Interviews/questionnaires/desk research	Respondents and official reports
			Quality of infrastructure (pavements, cycling lanes)	Qualitative	Interviews/questionnaires/desk research	Respondents and official reports
		Private car	*Multimodal infrastructure at schools and businesses*	Quantitative & Quantitative	Interviews/questionnaires/desk research	Respondents and official reports
			Change in fiscal incentives for car ownership	Qualitative	Interviews/desk research	Political and stakeholders representatives, official reports and newspaper articles
	Modal shift	Public transportation	*Modal share increase compared to baseline*	Quantitative & Quantitative	Interviews/desk research	Political and stakeholders representatives and official reports
			Modal share in %	Quantitative & Quantitative	Interviews/desk research	Political and stakeholders representatives and official reports
		Active transportation (cycling, walking)	*Modal share increase compared to baseline*	Quantitative & Quantitative	Interviews/desk research	Political and stakeholders representatives and official reports
			Modal share in %	Quantitative & Quantitative	Interviews/desk research	Political and stakeholders representatives and official reports
		Private car	*Modal share change compared to baseline*	Quantitative & Quantitative	Interviews/desk research	Political and stakeholders representatives and official reports
			Modal share in %	Quantitative & Quantitative	Interviews/desk research	Political and stakeholders representatives and official reports

3.3 challenges and limitations

One of the main challenges arose in the identification of questionnaire respondents, due to the sample comprised hard to find, informed, participants. This challenge was overcome using referrals to identify potential respondents. Similarly, the ongoing COVID-19 pandemic limited the accessibility of respondents, this impacted the data collection for the interviews. Budgetary and temporal constraints also constrained the research, this will likely have an impact on the analysis results. Triangulation was furthermore limited, though not impossible. The lack of a significative correlation (under 95%) entailed correlation analysis findings could not be used. Finally, potential bias towards the research subject was acknowledged and addressed by verifying findings using multiple data sources and using respondent verification for interviews. The research acknowledges alternative explanations, though these go beyond the scope of the study.

Chapter 4: Presentation of data and analysis

4.1.Description of the case

The IRIS I plan marked the first time the BCR would work with a defined strategy and framework for mobility matters. Doing so, it strived to ensure the city's competitiveness whilst stimulating strategic development. However, authorities failed to implement some important measures. As a consequence, by 2010 traffic had reduced the quality of life and many public squares had been converted and sidewalks became less wide to provide more parking space. Increased traffic had also slowed down the transit speed of above-ground public transportation (Dobruszkes, 2009). As a result, systematic congestion ensued. Brussels' mobility experts anticipated the existing infrastructure would not be able to absorb the predicted traffic increase (Thiry and Bruxelles Mobilité, 2011).

Based on this alarming prognosis, the regional authorities set out to offer more efficient and comfortable mobility, to benefit all inhabitants. Effectively, this translated into the creation of the IRIS II regional mobility plan which set out to improve regional accessibility and quality of life. It also aimed to develop modal alternatives and promote a modal shift, to reduce congestion. However, objectives were threatened by the institutional and organizational shortcomings of the previous plan. Therefore, the implementation of actions required institutional cooperation and proper M&E to assess their effects of implemented actions (Thiry and Bruxelles Mobilité, 2011).

Thus, the IRIS II plan vowed to address the institutional shortcomings of the IRIS I plan to achieve the objective. Nevertheless, the proposed plan barely addressed previously identified institutional and organizational shortcomings. Without sufficient public support and political motivation, the implementation of actions and achievement of objectives looked challenging. Nonetheless, the development of modal alternatives became a guiding principle to induce a modal shift. This chapter presents the findings derived from the analysis; it elaborates on the impact of the identified influential factors towards developing modal alternatives and the achieving modal shift targets.

4.2 Description of the sample

This chapter presents insights from empirical findings collected using interviews, questionnaires and desk research. In doing so, the researcher contacted various ministries, municipalities, local institutions, organizations and NGO's in the BCR. For the interviews the sample includes representatives from political institutions and stakeholder organizations.
The questionnaire was shared with the administration of all municipalities, the regional mobility administrative staff, the administration of the Brussels Intercommunal Transport Company (hereinafter STIB-MIVB), staff of the National Railway Company of Belgium (NMBS/SNCB), representatives of the regional mobility commission (GMC/CRM), stakeholders and commuters.

4.2.1 Primary data

This section discusses the data collection from both questionnaires and interviews, it shows a comparison between the proposal described in chapter 3. Table 3 shows the number of respondents for questionnaires and interviews.

Table 3 Primary data respondents

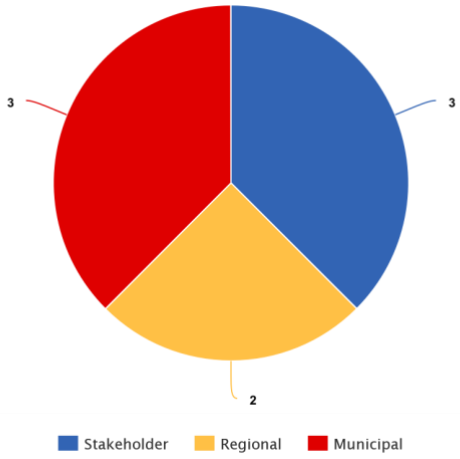
Data Collection Method	Collected
Questionnaires	87
Interviews	8

N=95

Interviews

The interviews were conducted both online and face-to-face. With the permission of participants (summarized in table 1), all interviews were recorded and transcribed. The transcriptions were subsequently coded and analyzed using the Atlas.ti software (Co-occurrence and query tool). The low response rate (8 respondents) is related to reduced accessibility resulting from the ongoing pandemic. The final sample is based on non-probability purposive sampling. The list includes representatives from the municipalities of; Jette, Woluwe-saint-lambert and Auderghem. Regional representatives such as; the ex-secretary of state for Mobility, the mobility ministry spokesperson, a regional mobility advisor, a spokesperson for the Brussels-capital Region bike observatory (pro.vélo) as well as a spokesperson representing parents of accidented children. Chart 3 presents them as subdivided into categories. This instrument was used for all variables and sub-variables.

Chart 1 interview respondent per category



N=8

Questionnaire

The initial strategy for collecting questionnaire responses strived to contact respondents who actively participated in the development and/or implementation of the IRIS II plan. However, the questionnaire was adapted to focus on the perceptions, for the intervening variable, of administrators, stakeholders and commuters. This strategy ensured a higher response rate as it allowed for respondents to partake in the questionnaire, regardless of their involvement in IRIS II. Using non-probabilistic snowball sampling, the final list of questionnaire respondents comprised of 87 respondents (annex 2). These can be subdivided into various groups, namely; 23 in the municipal administration, 5 from regional administration, 9 from the regional mobility commission, 27 from stakeholder organizations, 11 from NGO's and 12 independent citizens. This sample size was based on the population size of approximately 250 people with a confidence interval of 95%. The sample characteristics are summarized in the following section**.** The responses were subsequently analyzed using SPSS and excel.

The data was collected using an online survey, this helped overcome challenges related to the ongoing COVID-19 pandemic. It proved to be a cost effective and time efficient method allows for a larger reach and diversified group of participants (DeWaele, 2018). Moreover, online surveys benefit from enhanced honesty in the responses, due to respondent anonymity.

The questionnaire data only provided data for some of sub-variables under the intervening variable, namely: network length (public transportation), kilometers of active transportation network (pavements, cycling lanes), quality of infrastructure (pavements, cycling lanes) and multimodal infrastructure at schools and businesses.

Chart 1 shows 47% of questionnaire respondents participated in the development and/or implementation whilst 53% did not participate in any way, though the respondent characteristics implies they were informed of the plan. Chart 2 shows only 9% of respondents are not residents of the BCR, whilst the majority, 91%, are residents. Graph 1 indicates a majority of female respondents (47), with 37 male respondents.

Chart 2 Participation of Respondents

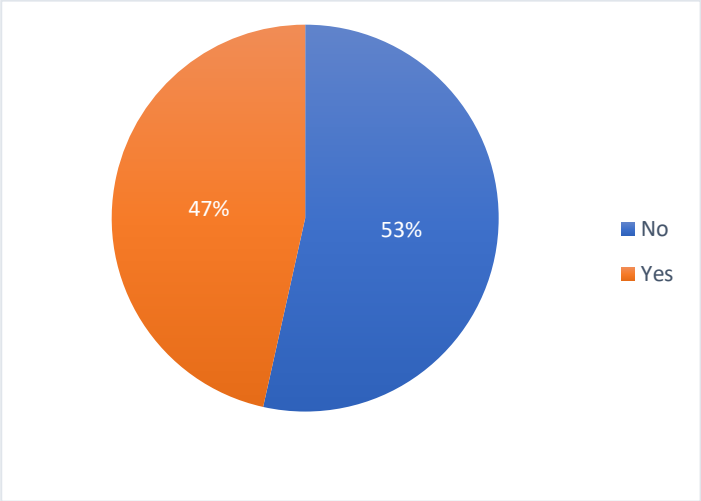
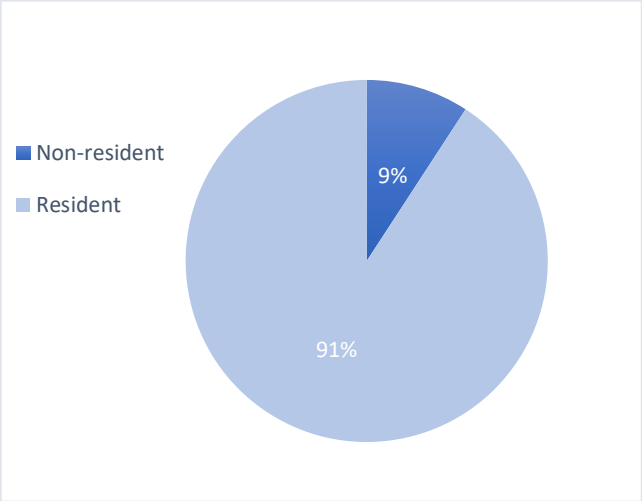
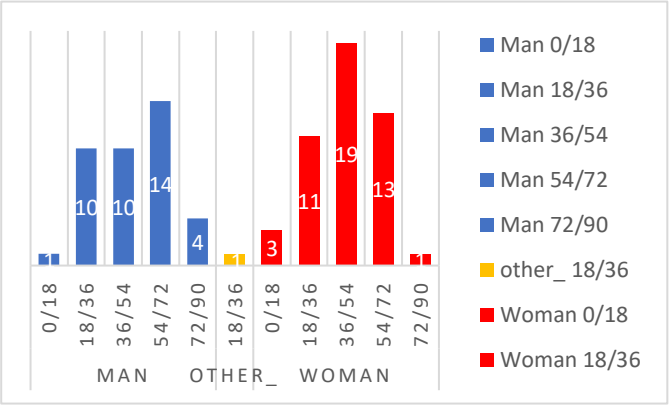


Chart 3 Residents of BCR



Graph 1 Respondents per age and Gender



4.2.2 Secondary data

The analysis of various documents, reports and websites allowed for a deeper understanding of findings. These sources helped investigate the initial development and consequent implementation of the IRIS II plan. Based on the cross-referencing with data derived from the primary sources, secondary data gave a deeper understanding of the findings per indicator.

4.3 Presentation and analysis of data of research questions.

4.3.1 Presentation and analysis of data per research question

The following section presents data per sub-research question of the study, it is organized according to the indicators used under each sub-variable. The analysis starts with an overview of the main findings from the interview responses, denoted as R1 to R8 (table 1). Sub-research question 1 uses interview data and secondary data. When possible, sub-research question 2 triangulates secondary data with results from questionnaires and interview, the remaining sub-variables use interview and secondary data to cross-reference the findings. Findings per sub-research question analysis are summarized with a short description of significant findings.

Findings per sub-research question

Sub-Research Question I

How did the identified influential factors impact the development of modal alternatives?

This research questions aims to expose how the various identified influential factors (independent variable) impacted the development of modal alternatives (intervening variable). Doing so, the analysis also identifies alternative influences.
The analysis for this sub-research question focused on using interview responses (table 1) as well as desk research findings to elaborate on the following sub-variables; the lack of institutional cooperation, the inconsistent stakeholder and citizen consultation and improper monitoring and evaluation, using their corresponding indicators; *actor representation, information sharing, implementation of actions, diversity of consulted stakeholders and citizen, frequency of stakeholder and citizen consultation, reason for stakeholder and citizen consultation, frequency of monitoring activities* and *number of evaluation reports*.

Variable: identified influential factors

Sub-variable: Lack of institutional cooperation

Indicator: Actor representation and information sharing

Table 4 (interview) frequency distribution: actor representation and information sharing

Authority	Frequency of disagree
Municipal	2/3
Regional	2/3
Stakeholder	1/1
Total of respondents	5/8

N=8

Table 4 shows 5/8 respondents expressed insufficient actor representation and information sharing throughout the IRIS II period. Interview responses stated that regional authorities (i.e. the ministries) led both the plan development and implementation, suggesting it was developed within the administration of the mobility ministry. R2 stated "regional authorities did not consult with my municipal administration regarding our needs", R5 confirmed "the IRIS II plan was developed internally (by the mobility ministry) […] the perspectives of municipalities and stakeholders could be disregarded […]." This indicates that it was not an integrative decision-making process, as municipalities and other stakeholders were not asked to cooperate in the development of the plan. Moreover, R2 stated "[…] regional authorities would use meetings to reiterate their vision and ambition, and reminded actors of their rights and obligations[…]" (Delvaux, 2011). Effectively these meetings failed to manage expectation and did not promote long-term cooperation.

Respondents argued actor representation and information sharing improved with the IRIS II implementation. R4 shared the regional authorities "simply needed to ensure municipal actors felt represented because voluntary cooperation meant the region relied our support for the regional ambitions." R2 found "we were asked to approve the proposed ambitions, though we did, we also knew it was merely symbolic in the long run." As such, municipal representation entailed approving the proposal and did nothing to ensure continuous support. However, it pushed municipalities to develop municipal mobility plans, done by 15/19 municipalities, to ensure objectives were met in their municipality(Delvaux, 2011). However, R1 found "municipal collaboration required significant efforts for all proposed actions" and R4 confirmed "we (municipal representatives) would express our discontent during the 'meeting of mayors', this would sometimes lead to a municipal front against regional ambitions, sometimes resulting in stagnation." Municipalities used their institutionalized representation to express opposition to regional ambitions, this facilitated the lack institutional cooperation due to inconsistent support. Nevertheless, R2 stated "the region would incentivize cooperation using grants, meaning municipalities would be rewarded for cooperating."

Indicator: Implementation of actions

Table 5 (interviews) frequency distribution: implementation of actions

Authority	Frequency of disagree
Municipal	3/3
Regional	2/3
Stakeholder	0/2
Total of respondents	5/8

N=8

Table 5 indicates 5/8 of respondents felt involved in the implementation of the proposed actions. Effectively, 3/8 respondents R2, R4 and R3 (box 1 in annex 3 for response summary) stated the implementation of actions was inconsistent and sometimes deviated from planned actions. Moreover, R1 stated, "[…] we (regional authority) lacked executive powers, this caused delays in the implementation as the Brussels Mobility had to hire third parties for everything we did." This led to increased financial costs and delays due to tendering procedures. R1 also found regional authorities "lacked regulatory power, we could not force anyone to cooperate for mobility matters. With the 2013 state reform, I pushed for more autonomy for the region to accelerate developments." R5 (response in box 1 annex 3) argued the plan's indicative statute entailed that before the 2013 state reform, the implementation of actions rested on the notion of voluntary cooperation, which municipal representatives R2 and R4 (box 1 annex 3) found to be impeded due to the lack of municipal consultation.
R1 and R5 (response in box 1 in annex) suggested the implementation of actions for the achievement of objectives was accelerated towards the end of the plan with the newly elected political coalition and the 2013 state reform. This gave the plan a regulatory statute and facilitated the enforcement of coordination mechanisms. This helped provide the necessary infrastructure to achieve the targeted modal shift.

Sub-variable: Inconsistent stakeholder and citizen consultation

Indicator: Diversity of consulted stakeholders and citizens

Table 6 (interview) frequency distribution: diversity of consulted stakeholders and citizens

Authority	Frequency of disagree
Municipal	1/3
Regional	2/3
Stakeholder	1/2
Total of respondents	4/8

N=8

Table 6 shows 4/8 interviewees felt the consulted stakeholders and citizens were diverse. Though initially planned to be a participatory planning process, respondents suggested the development of the IRIS II plan was done without much consultation with municipalities, citizens and stakeholders. Instead, R6 reiterated "it was developed internally by experts from Brussels Mobility" R2 finds that this entails many municipalities could not "express concerns."

Moreover, R3 found stakeholders such as the STIB-MIVB and pro.vélo were "barely consulted […]", this created difficulties to gather support and create a sense of policy ownership (Lindenau et al., 2016). R4 found the lack of consultation entailed "many actions (i.e. the development of cycling paths) were perceived as threatening towards the preference of residents (the motorists)", as representatives we had to express this opposition.
R8 reiterated that, during the implementation period, "consultations regarding proposed actions were mostly conducted with the regional mobility commission of Brussels*"* which was set up in 2000 as an advisory body. However, R8 once more suggests the "advises were often disregarded to preserve the political majority."

Indicator: Frequency of stakeholder and citizen consultation

Table 7 (interview) frequency distribution: frequency of stakeholder and citizen consultation

Authority	Frequency
Municipal	2/3
Regional	1/3
Stakeholder	0/2
Total of respondents	3/8

N=8

Table 7 indicates only 3/8 respondents felt frequently consulted. Effectively, mobility advisor R8 states that throughout the initial preparation phase "a citizen panel was consulted on a semi-regular basis, but I do not know what happened with the findings." During the implementation, R8 suggests consultations were more consistent. He finds that, "the 'meeting of mayors', meetings of the *regional mobility commission of Brussels* were regularly taking place." However, at the municipal level R6 suggests only few municipalities regularly consulted stakeholders and citizens. Instead he suggests that "other municipalities have consultations when it concerns regional roads, for this they work with the regional authorities as it is a requirement."

Indicator: Reason for stakeholder and citizen consultation

Table 8 (interview) frequency distribution: reason for stakeholder and citizen consultation

Authority	Frequency
Municipal	1/3
Regional	1/3
Stakeholder	1/2
Total of respondents	3/8

N=8

Table 8 indicates 3/8 interviewees felt they knew, ahead of time, what the reason for consultations were. Municipal representative R6 suggests only two of the 19 municipalities regularly allow citizens to participate in the development of actions: "if municipalities consult stakeholders and citizens, it is when a plan is adopted. They organize meetings to inform the concerned citizens." R2 confirms "[…] we informed citizens of planned actions during the consultations." R2 feared feedback as "concerned citizens were more likely to attend consultations and express their displeasure […]" this "could cause stagnation." R2 suggests "[…] our experts do not have sufficient experience with such participation activities." This suggests a lack of mixed participants and little experience causes fears that citizen inputs may unfavorably influence the final outcome. R2 found the development of active transportation

would be most negatively impacted by such consultations, as automobilists "feared losing valuable parking space." Thus, whilst some municipalities, such as Woluwe-Saint-Lambert and Woluwe-Saint-Pierre have a long tradition of consulting citizens for new developments, others, such as Jette, are still developing this culture. At the regional level, consultations were commonplace, though R2 finds "these were mainly aimed at informing citizens of already agreed upon ambitions." Similarly, R5 confirmed regional authorities "would ensure the decisions taken preserved the political majority […] and resort to informative consultations with citizens."

Sub-variable: improper monitoring and evaluation

Indicator: Frequency of monitoring activities

Table 9 (interview) frequency distribution frequency of monitoring activities

Authority	Frequency
Municipal	3/3
Regional	3/3
Stakeholder	1/2
Total of respondents	7/8

N=8

Table 9 indicates 7/8 respondents agreed M&E was not frequently done. Despite claiming the monitoring of the modal share developments would happen every three years, secondary data and interview respondents suggest limitations were impeding the M&E (Bruxelles mobilité, 2018). Respondent R5 finds "municipal and regional authorities lack adequate measurement instruments", the spokesperson for the mobility ministry continued with saying this ultimately led to "inconsistent measurement strategies." R2 agreed such factors negatively influenced the ability of municipalities to promptly conduct monitoring stated they, "lacked time and capacity to conduct such activities" This entailed authorities were likely ill-informed, and M&E was inaccurate. R3, claims that only pro.vélo consistently monitored the developed of a cycling culture in the region, monitoring developments "four times a year", with a consistent methodology, as supported by the literature (pro.vélo, 2016).

Indicator: Number of evaluation reports

Table 10 (interview) frequency distribution: number of evaluation reports

Authority	Frequency
Municipal	3/3
Regional	2/3
Stakeholder	1/2
Total of respondents	6/8

N=8

Table 10 indicates 6/8 respondents stated there were insufficient evaluation reports. Whilst the proposal promised two evaluation reports (in 2015 and 2018), Secondary data confirms the evaluation only took place towards the end (Bruxelles mobilité, 2018). Regional mobility expert, R8, stated the lack of evaluation reports is related to the "lack of adequate measuring instruments" contributed to the improper monitoring, needed for evaluation reports.

Summary of sub-research question I

The findings indicate 6/8 respondents found there was insufficient actor representation and information sharing during IRIS II. Whenever municipalities were contacted, they felt underrepresented, as R2 stated her municipality felt systematically "disregarded by the political majority." Similarly, the sharing of information during consultations focused on reiterating the "vision and ambition" and reminded actors of their obligations. Moreover, 3/8 respondents found the implemented actions were inconsistent. Regional representative R1 related this to the "lacked regulatory power" to enforce developments. However, respondents find the state reform of 2013 helped the development of planned actions.
6/8 respondents found the diversity of consulted stakeholders and citizens to be insufficient. 4/8 respondents mentioned the plan was developed internally, without frequent consultation. Moreover, R2 finds consultations were often merely informative. Finally, 7/8 respondents shared that improper M&E was related to insufficient measurement instruments. This led to "inconsistent measurement strategies as well as variations in what would be monitored." R5 finds the evaluation only took place in "preparation of the next regional mobility plan."

Sub-research question II

To what extent did the development of modal alternatives generate a modal shift in Brussels?

The second sub-research making elaborates on the extent to which the development of modal alternatives (intervening variable) provided the necessary conditions to induce a modal shift (dependent variable).
The questionnaire was used for the following indicators: *network length public transportation, kilometers of active transportation network (pavements, cycling lanes), quality of infrastructure (pavements, cycling lanes) and multimodal infrastructure at schools and businesses.*
This was complemented with interview findings (respondents table 1) for the following indicators: *network length (public transportation), frequency and speed of transit (public transportation), multimodal infrastructure and services at public transportation stations, commuter service satisfaction, kilometers of cycling lanes and sidewalks, quality of infrastructure (pavements, cycling lanes), multimodal infrastructure at schools and businesses, change in fiscal incentives for car ownership, modal share in % (public transportation), modal share increase compared to baseline (public transportation), modal share in % (private car), modal share increase compared to baseline (private car), modal share in % (active transportation) and modal share increase compared to baseline (active transportation).*

Intervening variable: Development of modal alternatives

This section presents the findings for the intervening variable. It uses interview data to cross-reference secondary data, though triangulation (using the questionnaire findings) happens for some of the indicators. As aforementioned, the correlation analysis did not provide significant p-value results (under 95%), the results can therefore not be used. The lack of significance suggests alternative explanations were more significant in inducing a modal shift.

Sub-variable: Public transportation

Indicator: Network length (public transportation)

Table 11 (interviews) frequency distribution: network length (public transportation)

Authority	Frequency
Municipal	3/3
Regional	3/3
Stakeholder	2/2
Total of respondents	8/8

N=8

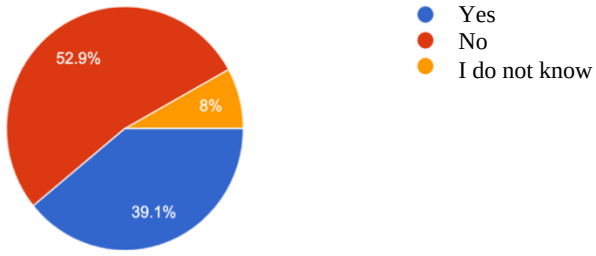
Table 11 shows 8/8 interview respondents agreed the length of the public transportation network had somewhat increased, though respondents found this was limited. R6 suggested, "three tramlines were launched, and another one was extended" this extended the reach towards developing neighborhoods. They also stated one bus line was created to improve accessibility in the city center (see box 3 in annex 2 for response summary). The developments were confirmed using secondary data (table 12).

Table 12 (secondary data) New bus and tram lines from IRIS II

Bus/Tram Number	Intervention	Year
Tram # 93	Inauguration of new tram line between *Stade* and *Legrand* terminals. It also takes over part of the route of line 94	2013
Tram # 62	The new tram line connects Haren and Schaerbeek, it is subsequently extended towards Jette	2011 & 2014
Tram # 8	Extension of line 94 towards, which becomes line 8	2018
Bus # 33	Inauguration of first 100% electric bus line	2018
Tram # 9	Inauguration of new tram line 9, between the Simonis multimodal station and Arbre Ballon terminus	2018

(Brussels mobility, 2020)

Chart 4 Results of the questionnaire response: network length (public transportation)



N=87

The questionnaire helped gain insights into the perceptions of stakeholders and other commuters, in Chart 4 respondents were asked whether they believed the length of the public transportation network had increased, 52,9% of respondents found it had. The results of the

interviews, secondary data and the questionnaire providing robust evidence to conclude the network length increased.

Indicator: commuter service satisfaction

Table 13 (interviews) frequency distribution: commuter service satisfaction

Authority	Frequency of confirmation
Municipal	1/3
Regional	3/3
Stakeholder	0/2
Total of respondents	*4/8*

N=8

Table 13 shows 4/8 interview respondents found commuter service satisfaction had improved as a consequence of the implemented actions. R8, a representative from the regional mobility commission stated: "the STIB-MIVB is a good service provider and benefits from high commuter satisfaction, I would give them a good rating." Similarly, municipal council member R6 stated: "for a while we had a complicated relation with STIB-MIVB, but it has improved since the new tramline arrived." STIB-MIVB's yearly report supports their claims, it indicates customer satisfaction increased from 6/10 in 2010 to 7/10 by 2018 (STIB-MIVB, 2010; STIB-MIVB, 2018).

Indicator: Frequency and speed of transit

Table 14 (interview) frequency distribution: frequency and speed of transit

Authority	Frequency of confirmation
Municipal	1/3
Regional	3/3
Stakeholder	0/2
Total of respondents	*4/8*

N=8

Table 14 shows 4/8 respondents agreed the frequency and speed of transit of public transportation had increased. R1 suggested the provision of separated bedding for above-ground public transportation improved frequency and transit speed by 20%. R5 found increased punctuality and information regarding the frequency had induced a modal shift (response summary in annex 3). Table 15 shows secondary data confirms the frequency was improved, it details the undertaken actions to increase frequency and transit speed. Despite claims from interview respondents, the STIB-MIVB annual reports indicate the planned transit speed of public transportation was reduced (summarized in table 16). Secondary data suggests this may be related to congestion issue (Delvaux, 2011). Interviewees and secondary data contradict each other regarding the changes in transit speed, though both agree the frequency has increased, suggesting developments mainly benefitted frequency on the network, in support of the defined target.

Table 15 (secondary data) Public transportation interventions

Year	Intervention
2012	The frequencies of the metro increases, with a train every 2min30 on the common core of lines 1 and 5. That is to say 3,000 additional places during rush hour
2013	Increasing the frequencies of 22 bus lines and 8 tram lines
2015	Installment of 300 new waiting time displays at surface stops

(STIB-MIVB, 2018)

Table 16 (secondary data) Change in transit speed between 2010 and 2018

Year	Average transit speed	
2010	Bus	17,0 km/h
	Tram	16,7 km/h
	Metro	28,4 km/h
2018	Bus	15,9 km/h
	Tram	15,9 km/h
	Metro	28,0 km/h

(STIB-MIVB, 2010; STIB-MIVB, 2018)

Indicator: Multimodal infrastructure and services at public transportation stations

Table 17 (interview) frequency distribution: multimodal infrastructure and services at public transportation stations

Authority	Frequency of confirmation
Municipal	2
Regional	3
Stakeholder	1
Total of respondents	*6*

N=8

Table 17 shows 6/8 interview respondents confirmed multimodal infrastructure and services at public transportation stations improved. Municipal representative R6 found "the existing multimodal infrastructure and services remains insufficient […] though previous interventions increased the available options at our stations." Similarly, Pro.vélo, R3, found that "developments ensured some level of multimodality at most public transportation stations, but their visibility could improve." Indeed, Brussels mobility & STIB-MIVB's 2018 report confirms most metro and train stations provide bicycle parking racks. Since 2018, the beurs/bourse station offers dedicated parking space for +/-800 bicycles. STIB-MIVB's data indicates the MOBIB-card became compatible with Villo (city rental bike) subscriptions to improve multimodality in 2011. Both interview and secondary data findings confirm multimodal infrastructure and services at public transportation stations increased, though indicating developments were minor.

Sub-variable: private car

Indicator: Multimodal infrastructure at schools and businesses

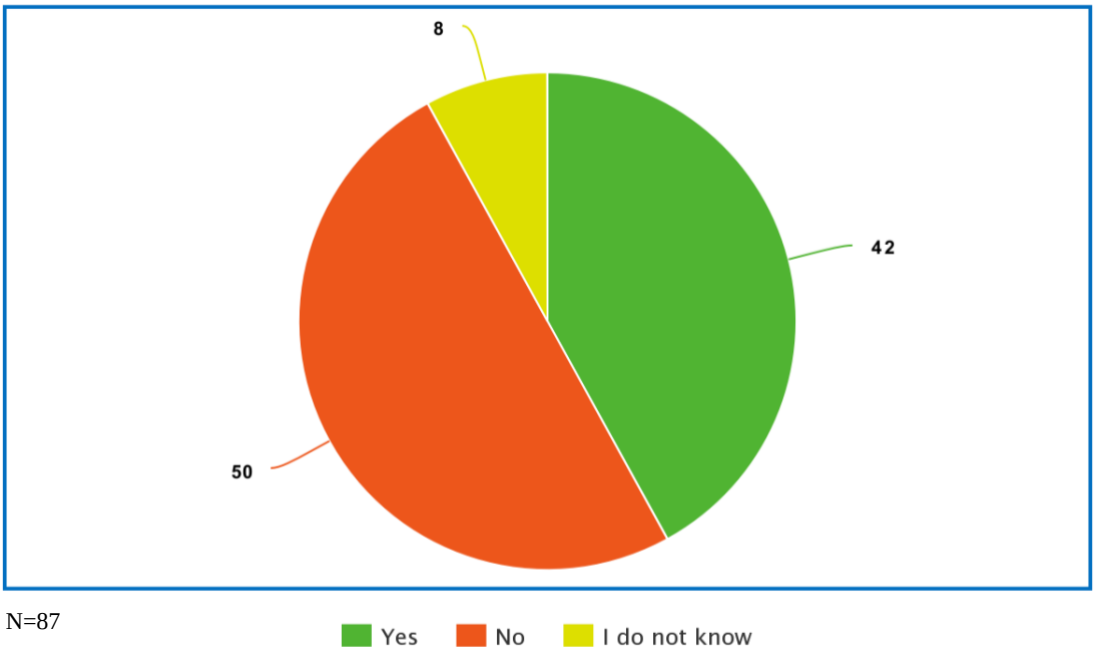
Table 18 (interview) frequency distribution: multimodal infrastructure at schools and businesses

Authority	Frequency of confirmation
Municipal	2/3
Regional	0/3
Stakeholder	1/2
Total of respondents	3/8

N=8

Table 18 shows 3/8 interview respondents found they were informed enough to share insights regarding the availability of multimodal infrastructure at schools and businesses. Respondent R3 stated pro.vélo provides support for businesses and schools to transition towards a biking culture. She confirmed, "we support regional authorities in facilitating a modal shift […] part of our activities includes assessing what type of multimodal infrastructure is needed at the schools and businesses." Effectively, pro.vélo's website confirms they work together with the European ByPad program to evaluate the needs of schools and businesses transitioning towards a cycling culture. However, no quantitative data is provided concerning such developments (Brussel Mobiliteit and STIB-MIVB, 2018; pro.vélo, 2018; pro.vélo, 2019).

Chart 5 Results of the questionnaire responses: multimodal infrastructure at schools and businesses



N=87

Chart 5 shows 42% of questionnaire respondents stated sufficient multimodal infrastructure was provided around schools and businesses. The correlation analysis (table in annex 2) did not provide significant results, this results may be related to the fact that most respondents worked in the public sector and are therefore ill-informed. Nonetheless, combining interviews,

questionnaires and secondary data confirm some developments were achieved, though it is hard to quantify how many.

Indicator: Change in fiscal incentives for car ownership

Table 19 (interview) frequency distribution: change in fiscal incentives for car ownership

Authority	Frequency of confirmation
Municipal	3/3
Regional	2/3
Stakeholder	1/2
Total of respondents	*6/8*

N=8

Table 19 shows 6/8 interview respondents found there were no major changes in fiscal incentives for car ownership. Respondent R5 stated, "this is a federal competence which is not in the hands of the regions." However, respondent R8 shared the cash for cars scheme had been undertaken by the federal government. Secondary data confirms the 'cash for cars' scheme allowed to exchange company cars for a mobility allowance (Deloitte Belgium, 2017). However, further investigation reveals it was abolished in 2020 (Santens, 2020). Already existing mileage allowances were not adapted, indicating that both interview and secondary data findings concur no major changes in fiscal incentives were adopted under IRIS II (Deloitte Belgium, 2017).

Sub-variable: Active transportation

Indicator: Kilometers of cycling lanes and sidewalks

Table 20 (interview) frequency distribution: kilometers of cycling lanes and sidewalks

Authority	Frequency of confirmation
Municipal	3/3
Regional	3/3
Stakeholder	2/2
Total of respondents	*8/8*

N=8

Table 20 shows 8/8 interview respondents agreed the kilometers of cycling lanes and sidewalks increased in the region. The IRIS II evaluation report confirms 91km of cycling lanes were developed (Delvaux, 2011). Similarly, Brussels mobility's data confirms approximately 50ha of public space was refitted to favor pedestrian mobility (Brussel Mobiliteit and STIB-MIVB, 2018). Despite this, R3 found this was "not the most significant factor inducing a modal shift." R3 further commented the increase results from other factors: "people feared public transportation following the 2016 metro attacks […] the closure of tunnels caused made cycling the most efficient mode of transportation, […] people became more environmentally conscious." Pro.vélo yearly reports confirm alternative factors (i.e. fear of public transportation) may contributed to a 30% increase of cyclists in 2016 compared to 2015 (pro.vélo, 2016). R1 found the " cycling developments did not lead to the desired results, but we continue to believe infrastructure is needed to incentivize a modal shift."

Municipal representative R4 found pedestrian infrastructure was adequate in their locality, however they found: "the quality of pavement leaves much to be desired." Regional representative R5 sug […] a thorough and comprehensive policy to make the city truly pedestrian-friendly at the benefit of those walking for their daily commutes."

Chart 6 Results of questionnaire responses (in %): size of network

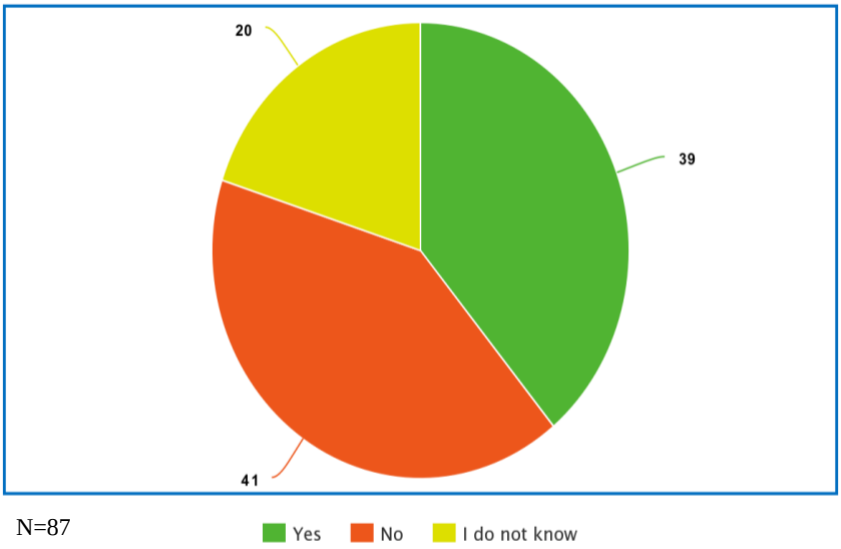
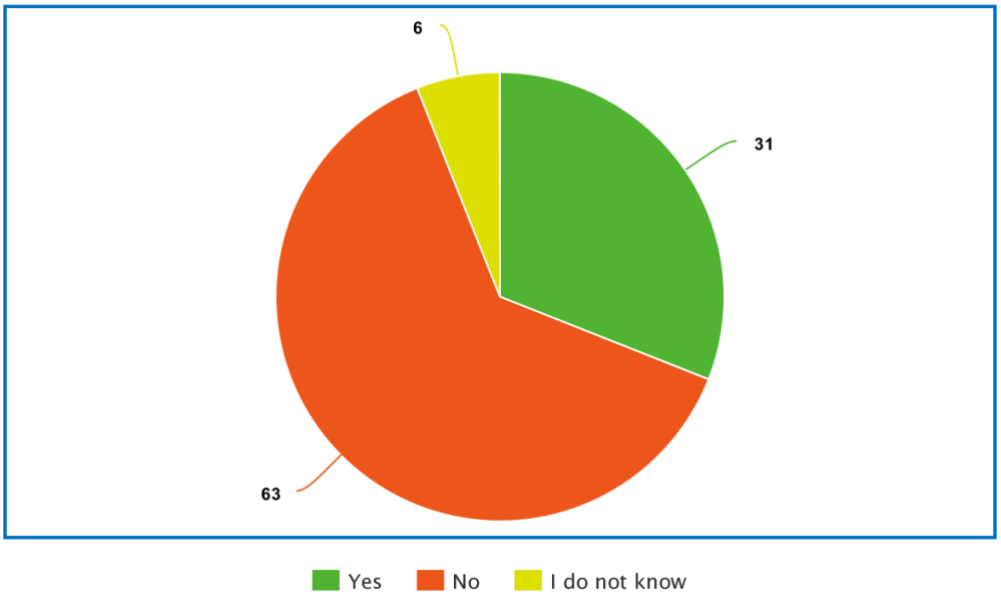


Chart 7 Results of questionnaire responses (in %): active transportation infrastructure and modal shift



N=87

39% of questionnaire respondents (Chart 6) confirmed they believed the investments in infrastructure had resulted in an extension of the active transportation network. Similarly, 31% of respondents (Chart 7) believed these infrastructural investments contributed towards inducing a modal shift in favor of active mobility. Effectively, the correlation analysis found

the strength of association was not statistically significant, though the answering options may influence these results. The data findings increased infrastructure was provided, though questionnaire responses and secondary data suggest the effects were moderate for promoting a cycling culture (Bruxelles mobilité, 2018).

Indicator: Quality of infrastructure (pavements, cycling lanes)

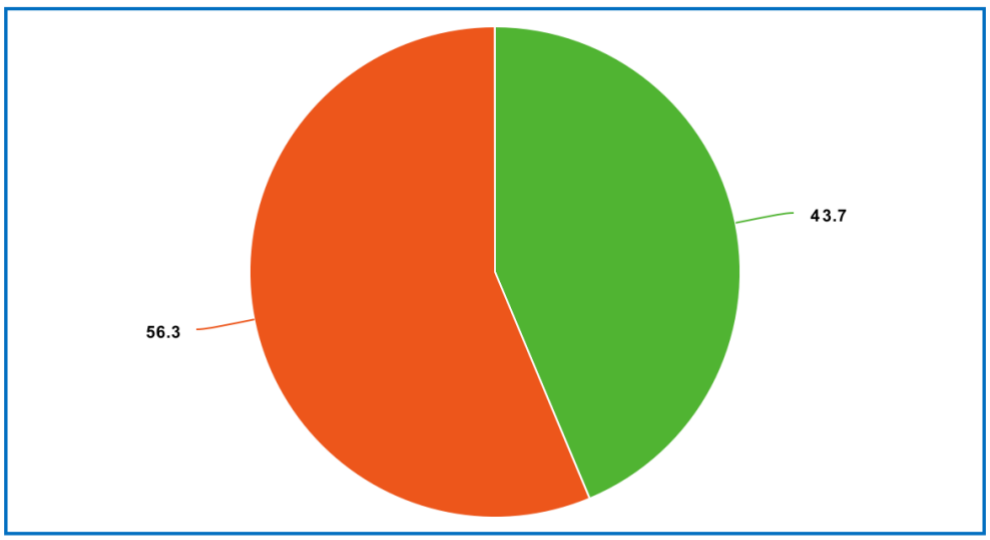
Table 21 frequency distribution: quality of infrastructure (pavements, cycling lanes)

Authority	Frequency of confirmation	Percentage
Municipal	2	25%
Regional	3	37,5%
Stakeholder	1	12,5%
Total of respondents	*6*	*75%*

N=8

Table 21 shows 6/8 found the quality of cycling and pedestrian infrastructure improved with the IRIS II plan. R1 stated, "the redevelopment of streets and squares was always done at the benefit of active users." R2 highlighted IRIS II pushed "the region to reconsider the adequate width of pavements […] from 1,5m to 2m (with car parking space) or 2,5m (if no car parking space) to increase the capacity and user-friendliness."
Secondary data confirms the regional authorities planned to build 20km2 of pedestrian areas, but it does not provide an evaluation. Likely due to a lack of data. Instead, regional authorities modified urban planning regulations to ensure increased accessibility for pedestrians and cyclists (Thiry and Bruxelles Mobilité, 2011).
Respondents R3 and R5 found the tradition of providing separated bike paths incurred additional risks for cyclists, respondent R3 stated, "it causes more accidents at major intersections because cars forget to look out for potential cyclists." Instead, R1 stated, "we (the regional authorities) actually prefer shared roads because they offer increased visibility." However, all respondents agreed that a major setback in the development of cycling lanes resulted from citizen opposition inspired by the rivalry between road users.
Chart 8 shows that only 43,7% of questionnaire respondents found the active transportation infrastructure to be in a good state. Thus, the combination of interview and questionnaire responses suggests increased investments in quality cycling infrastructure and pavements induced a modal shift.

Chart 8 Results of questionnaire responses (in %): quality active transportation infrastructure



Variable: Modal shift

The modal shift, dependent, variable makes use of interview findings, cross-referenced with secondary data to understand the extent of a modal shift following the development of modal alternatives. Respondents of the questionnaires were unlikely to be informed about quantified modal shift changes, thus the questionnaires were only used for the intermediate variable.

Sub-variable: Private car

Indicator: Modal share change compared to baseline

The IRIS II plan did not come forth with policy proposals aimed at reducing the number of cars and/or distance travelled by car within the region. R5 finds "[…] there were not enough fiscal incentives and actions to curb the proportion of car-based trips." Instead, it focused on the provision of viable alternatives.
Data regarding the distances travelled by car within the region is limited to 2016. It finds there was a decrease of 20% in distance travelled by car between 2001 and 2016, confirming the achievement of the target (Bruxelles Mobilité, 2020).

Indicator: Modal share in %

Stakeholder R3 found the modal share of cars had reduced, though "it depends on how you define and measure it." Indeed, the new mobility plan suggests the modal share had reduced by 10% in 2015 and 20% in 2018 compared to 2001. However, it finds "The objective concerns the distances traveled and not a number or proportion of trips (Bruxelles Mobilité, 2020) Stakeholder respondent R3 found this was common practice, as it "helped make sure the objective would be met based on the type of measurement used." As such, though the data confirms the modal shift target was achieved, no data is available regarding the true proportion of trips done by car (Bruxelles mobilité, 2018).

Sub-variable: public transportation

Indicator: Modal share increase compared to baseline

Table 22 (interview) frequency distribution: modal share increase compared to baseline

Authority	Frequency of confirmation
Municipal	2/8
Regional	3/8
Stakeholder	1/8
Total of respondents	*6/8*

N=8

Table 22 shows 6/8 respondents found the modal share of public transportation had increased. R1 stated, "we noticed a sharp increase in the use of public transportation inside the region […] the increased frequency and transit speed increased ridership." Stakeholder R3 commented "[…] people generally shift from cars towards public transportation […]." Despite major setbacks in the popularity of public transportation following the 2016 attacks on a Brussels metro station, the STIB-MIVB confirms ridership increased from 311.600.000 yearly travels

in 2010 to 417.600.000 in 2017. This confirms the public transportation target was achieved (STIB-MIVB, 2010; STIB-MIVB, 2017).

Indicator: Modal share in %

Table 23 (interview) frequency distribution: modal share in %

Authority	Frequency of confirmation
Municipal	0/8
Regional	3/8
Stakeholder	0/8
Total of respondents	*3/8*

N=8

Table 23 shows 3/8 interview respondents gave insights regarding the modal share in percentages. Former state secretary R1 shared "our intention was never to quantify the share of trips done by public transportation." Respondent R5 found "the aim of IRIS II was to make the system more efficient and attractive but failed to quantify the share of trips done by public transport." Indeed, a prospective study conducted in preparation for the 2020-2030 mobility plan estimates the share of public transportation to be between 11% and 28% (Bruxelles Mobilité, 2020). These findings raise questions regarding regional authorities' ability to monitor the true modal share of public transportation.

Sub-variable: Active transportation

Indicator: modal increase compared to baseline

Table 24 (interview) frequency distribution: modal increase compared to baseline (active transportation)

Authority	Frequency of confirmation
Municipal	3/8
Regional	3/8
Stakeholder	1/8
Total of respondents	*7/8*

N=8

Table 24 shows 7/8 interviewees confirmed an increase in active transportation throughout the region. R3 found people "are shifting towards active modes of transportation." However, when questioned about the number of cyclists and pedestrians, mobility ministry spokesperson R5 reiterated actors "did not have the necessary measuring instruments to quantify this […] we focus on quantifying the infrastructure." Nonetheless, data confirms the pedestrian modal target was achieved, though it does not provide updated data regarding the achieved increase in the modal share of cyclists, this inhibits the ability to provide conclusive statements about cycling developments (Brussel Mobiliteit and STIB-MIVB, 2018; Bruxelles Mobilité, 2020; pro.vélo, 2016).

Indicator: modal share in %

Table 25 (interview) frequency distribution: modal share in % (active transportation)

Authority	Frequency of confirmation
Municipal	1/2
Regional	3/3
Stakeholder	1/2
Total of respondents	*5/8*

N=8

Table 25 shows 5/8 respondents shared information regarding the increase of active transportation. R3 confirmed, "huge increase of almost 30% in 2016, it stagnated in 2017 and increased by over 10% in 2018." The yearly pro.vélo reports confirm R3's claims, it shows a huge increase of 30% in 2016, a small decrease of -0,8% in 2017 and an increase of 18% in 2018 (pro.vélo, 2016; Pro.vélo, 2017; pro.vélo, 2018). Regarding pedestrians, R1 commented, "we had achieved our target by late 2010." None of the respondents provided information for developments after 2011, though R1 mentioned: "we know this does not tend to change much." Secondary data collected from the IRIS II evaluation report confirms internal pedestrian mobility rose to 37% by 2010. Nevertheless, the final evaluation report and the new mobility plan continue to rely on outdated data, indicating the lack of reporting causes regional authorities to be continuously ill-informed regarding the true proportion of this modal shift (Bruxelles mobilité, 2018; Bruxelles Mobilité, 2020).

Summary of sub-research question II

Findings indicate 8/8 of interview respondents found the length of the public transportation network increased. 4/8 interviewees found the frequency and speed of transit increased, though the STIB-MIVB suggest there was a slight decrease (table 15). However, the number of yearly travels on the STIB-MIVB network increased by 106.000.000 trips over 7 years (STIB-MIVB, 2010; STIB-MIVB, 2017). This confirms the target for increased frequency and usage of public transportation was achieved (Bruxelles Mobilité, 2020).
6/8 interviewees found there were no changes with regards to fiscal incentives for car ownership as the main incentive was abolished in 2020. R5 mentioned the region "cannot do much about this." Nonetheless, data confirms the region successfully decreased the distance travelled by car by 20%, confirming the motorized transportation target was achieved (Bruxelles Mobilité, 2020).
8/8 interviewees found active transportation infrastructure increased, data confirms the development of 91km of cycling lanes and the refitting of approximately 50ha of public space for pedestrians. 31% of questionnaire respondents found this contributed towards inducing a modal shift in favor of active mobility. In contrast to the modal share of cyclists (7% instead of targeted 20%), data confirms the pedestrian modal share target was achieved under IRIS II (Brussel Mobiliteit and STIB-MIVB, 2018; Bruxelles Mobilité, 2020; pro.vélo, 2016).

Chapter 5: conclusions

Introduction

The main purpose of the study is to find out to what extent the identified influential factors have impacted the development of modal alternatives and to determine the extent to which it led to a modal shift in the BCR. Based on the literature review about urban mobility and the factors which influence its implementation, this study developed several important questions in the first part. Following the data collection and analysis, chapter 5 links these findings to the relevant literature to provide a conclusive answer for the research question. Based on this, the chapter aims to provide recommendations for future mobility planning policies and studies.

Main research findings

Conclusion sub-research question I

Research findings suggest the: lack of institutional cooperation, the inconsistent stakeholder and citizen consultations and improper monitoring and evaluation, had a moderate influence on the development of modal alternatives. Europe's platform on sustainable urban mobility plans highlights the key role of institutional cooperation for sustaining actor involvement and consequently ensuring each actor keeps to their respective responsibilities.
Literature suggests "Citizen engagement cannot be seen as a separate challenge […] but rather as an integrated part of the process of organizing and managing" projects, as citizen approval encourages institutional cooperation (Axelsson et al., 2010). However, findings suggest the lack of stakeholder and citizen consultation caused a lack of institutional cooperation for actions favoring active transportation: resulting in a lack of continuity for the development of active transportation infrastructure.
Leading development organizations find M&E documentation should track and assess the impacts of interventions throughout the plan's lifetime and should be referred to and updated regularly. However, findings highlight a lack of resources as well as a lack of information sharing for proper M&E activities. Consequently, authorities were systematically ill-informed and had no accurate instruments for monitoring modal developments, raising questions regarding the accuracy of the evaluation report (Akinleye, 2012; Axelsson et al., 2010; Cré et al., 2016).
Interview and secondary data analysis highlight a lack of vertical institutional cooperation, resulting from inconsistent stakeholder and citizen consultations. It finds the 2013 state reforms and election of a new political majority had a significant influence on accelerating planned developments. It nonetheless identifies a culture of uninformed decision-making, resulting from improper M&E activities. Thus, institutional cooperation lacked due to insufficient citizen engagement, this led to uninformed decision-making but only seems to have had a moderate influence on the development of modal alternatives.

Conclusion sub-research question II

Findings confirm the modal developments were generally favorable for a modal shift. Investments in public transportation have resulted in the achievement of the public transportation target. Findings also confirm a reduction of 20% in distance travelled by car, confirming this target was also achieved. Similarly, it confirms the pedestrian mobility targets were achieved, though it shows that it fell short for the cycling targets. This confirms that,

based on the targets, the objective: inducing a modal shift by developing modal alternatives, was achieved (Bruxelles Mobilité, 2020).
This reiterates previous findings, suggesting offering high-quality services and infrastructure induces a modal shift (Mobiel21, 2016). The research findings also indicate some developments (i.e. frequency of public transportation) were most significant for a modal shift. Finally, the findings indicate nothing was done to reduce the proportion of car-based trips, literature suggests this focus does not tackle the issue at hand, but rather denies the underlying cause of congestion (Mackett, 2012).

Conclusion main research question

Based on the findings of the sub-research questions, it can be said that: a lack of institutional cooperation, the inconsistent stakeholder and citizen consultation and improper monitoring and evaluation of the plan had a moderate influence on the development of modal alternatives. However, developments are more favorable towards certain modal alternatives (i.e. public transportation).
The research finds that the lack of institutional cooperation, between regional and municipal authorities, was directly related to the other identified influential factors. As such, the highly inconsistent stakeholder and citizen consultations limited knowledge exchange between the relevant actors and limited institutional cooperation, as the actions did not respond to the wishes and needs of civil society (Lindenau et al., 2016) As such, inconsistent stakeholders and citizen consultations and contributed to the sporadic active transportation infrastructure (i.e. cycling paths). Gerik and Parkin (2015 p.17) find fragmented infrastructure cannot induce a modal shift. The consistent development of public transportation benefitted from strong leadership and motivation (facilitated by the use of management contracts), this highlights the importance of defining obligations and expectations to facilitate institutional cooperation.
The lack of institutional cooperation accentuated the absence of proper measuring instruments and a common methodology. This reduced the quality of M&E activities and the implementation of actions. Kengera (2018) suggests the lack of accurate, updated information entails actions cannot be targeted enough. Thus, the improper M&E activities caused authorities to be unable to track progress.
However, the research concludes the objective and targets were achieved, as a modal shift was observed. Despite these achievements, the implemented actions do not seem to have changed the dominant position of motorized transportation within the region. Previous research highlights the value of doing so, as car-drivers often form a major front opposing the development of modal alternatives on public roads (Nello-Deakin, 2019). In fact, fearing opposition, Brussels' political officials lacked motivation to implement proposed developments.
However, the respondent characteristics and insignificant statistical results influenced these findings. As such, the questionnaire only allowed to triangulate a limited set of indicators under the intervening variable. A more comprehensive questionnaire could provide more significant findings and could help identify the true strength of association between two variables. The limited research period influenced the quality of the quantitative analysis and subsequent findings.
Nonetheless, the IRIS II plan achieved 3/4 targets, namely: the reduction of distance travelled by car by 20% between 2001 and 2018, the increased frequency and usage of public transportation by 2018 and increased modal share of pedestrians to 35% by 2018 (achieved 37% in 2011). This means that the corresponding objective was achieved, though factors such as the lack of proper instruments and methodologies to monitor certain developments (i.e. modal share of cyclists) raise questions regarding the legitimacy of reported data. This is further

highlighted by the lack of political motivation and citizen support, which had a moderate impact on the development of modal alternatives. Thus, Brussels' mobility planning continued to struggle with institutional and organizational issues, at the expense of mobility developments. Ensuring institutional cooperation remains a challenge that forms a recurrent stumbling block in defining a common development vision for Brussels. There is a need for powerful, region-wide, political and administrative coalitions to address the needs of Brussels's citizens.

Recommendation

To ensure institutional cooperation and societal support, the researcher suggest local authorities make use of more participatory decision-making. Based on the findings regarding public transportation, it also suggests making use of management contracts with a more diverse set of stakeholders and authorities to ensure structured cooperation and a commitment to the implementation of proposed actions. This would be particularly relevant for actors involved in monitoring and evaluation activities, it would ensure data is accurate and updated. This should benefit proposed actions, which would be more targeted and based on informed decision-making. It is also recommended that future mobility plans reiterate a need for infrastructure, to induce a modal shift in favor of active transportation. Finally, the researcher recommends future research to focus on measuring the proportional modal distribution as the absence of such accurate and updated information is worrying. Doing so, future research should strive to provide additional monitoring instruments and methodologies. As such, the newly adopted mobility plan reiterates the need for infrastructure for both pedestrians and cyclists, to increase the modal shift.

References

Akinleye, A. 2012. How to Develop a Monitoring and Evaluation Plan . Available at: https://www.thecompassforsbc.org/how-to-guides/how-develop-monitoring-and-evaluation-plan#:~:text=A%20monitoring%20and%20evaluation%20(M%26E,updated%20on%20a%20regular%20basis. [Accessed 22/08/].

Axelsson, K., Melin, U. and Lindgren, I., 2010. Exploring the importance of citizen participation and involvement in e-government projects. *Transforming Government,* 4(4), pp.299-321. 10.1108/17506161011081309 Available at: https://search.proquest.com/docview/761425228 [Accessed 22/08/2020].

Barbé, L. 2019. Belgium and its green parties at the crossroads. Available at: https://www.greeneuropeanjournal.eu/belgium-and-its-green-parties-at-the-crossroads/ [Accessed 07/06/].

Beauregard, R. 1989. Between Modernity and Postmodernity: The Ambiguous Position of US Planning. *Environment and Planning D: Society and Space,* 7(4), pp.381-395. 10.1068/d070381 Available at: https://journals.sagepub.com/doi/full/10.1068/d070381 [Accessed 20/05/2020].

Béland, D. and Howlett, M., 2016. The Role and Impact of the Multiple-Streams Approach in Comparative Policy Analysis. *Journal of Comparative Policy Analysis: Research and Practice: The Multiple-Streams Approach in Comparative Policy Research,* 18(3), pp.221-227. 10.1080/13876988.2016.1174410 Available at: http://www.tandfonline.com/doi/abs/10.1080/13876988.2016.1174410 [Accessed 22/08/2020].

Berger, N. 2018. Bruxelles
Un territoire métropolitain
à l'étroit. Bruxelles: Fédération Wallonie-Bruxelles. Available at: https://www.cpcp.be/wp-content/uploads/2018/09/bruxelles-territoire-etroit.pdf [Accessed 20/05/2020].

Brilhante, O. and Klaas, J., 2018. Green City Concept and a Method to Measure Green City Performance over Time Applied to Fifty Cities Globally: Influence of GDP, Population Size and Energy Efficiency. *Sustainability,* 10(6), pp.2031. 10.3390/su10062031 Available at: https://search.proquest.com/docview/2108752924 [Accessed 09/08/2020].

Brussel Mobiliteit and STIB-MIVB, 2018. Opvolging van het Beheerscontract
Rapport 2018 . Brussels: MIVB. Available at: https://mobilite-mobiliteit.brussels/sites/default/files/opvolging_van_het_beheerscontract_rapport_2018.pdf [Accessed 22/08/2020].

Brussels mobility. 2020. Who we are. Available at: https://mobilite-mobiliteit.brussels/en/who-we-are [Accessed 09/08/].

Bruxelles Mobilité. 2020. Plan régional
de mobilité

2020-2030. Brussels: Bruxelles mobilité. Available at: https://goodmove.brussels/wp-content/uploads/2020/05/13405_FR_COMPLET_RVB_20200430.pdf [Accessed 22/08/2020].

Bruxelles mobilité. 2018. Quelle évaluation du Plan IRIS II ? . Brussels: Bruxelles.mobilité. Available at: https://goodmove.brussels/fr/2018/05/07/iris2/ [Accessed 22/08/2020].

Campbell, S. 1996. Green cities, growing cities, Just cities? Urban planning and the contradictions of sustainable development. *Journal of the American Planning Association*, 62(3), pp.296-312. 10.1080/01944369608975696 Available at: http://www.tandfonline.com/doi/abs/10.1080/01944369608975696 [Accessed 10/02/2020].

City of Brussels. 2020. Charter for Citizen Participation . Brussels: Ville de Bruxelles. Available at: https://www.brussels.be/charter-citizen-participation [Accessed 20/05/2020].

Committee of Regions. 2019. From local to European: Putting citizens at the centre of the EU agenda. Brussels: Publications Office. Available at: http://publications.europa.eu/publication/manifestation_identifier/PUB_QG0319597ENN [Accessed 20/05/2020].

Cré, I., Ryder, A., Heckley, S., Balant, M. et al., 2016. Institutional cooperation: working jointly with institutional partners in the context of Sustainable Urban Mobility Plans. Brussels: European Commission. Available at: https://www.eltis.org/sites/default/files/sump-manual_cooperation_en.pdf [Accessed 22/08/2020].

Deloitte Belgium. 2017. L'allocation de mobilité, aussi appelée « Cash for Car », est-elle une alternative pertinente aux voitures de société? Brussels: Deloitte. Available at: https://www2.deloitte.com/content/dam/Deloitte/be/Documents/tax/Deloitte-Mobility-Allowance_FR.PDF [Accessed 22/08/2020].

Delvaux, P. 2011. Plan régional de développement durable . Brussels: Trait d'union. Available at: file:///Users/paul/Downloads/2011-12-interview_prdd.pdf [Accessed 22/08/2020].

Dobruszkes, F. 2009. Retour à Bruxelles : le projet de plan IRIS II. *Transports Urbains*, 116(2), pp.15-18. 10.3917/turb.116.0015 Available at: https://www.cairn.info/revue-transports-urbains-2009-2-page-15.htm [Accessed 22/08/2020].

European Committee of Regions. 2019. Belgium - Fiscal Powers. Available at: https://portal.cor.europa.eu/divisionpowers/Pages/Belgium%20fiscal-Powers.aspx [Accessed 13 December].

Gerike, R. and Parkin, J., 2015. Cycling Futures: From Research into Practice. Farnham: Ashgate. https://doi.org/10.4324/9781315575742 Available at: https://books.google.be/books?id=bri1CwAAQBAJ&pg=PT215&lpg=PT215&dq=the+consequence+of+motorization+on+walking+and+cycling&source=bl&ots=oMZsP0plUi&sig=ACfU3U02HM9X03Au9kjhbq7KxgzAgmC4Iw&hl=en&sa=X&ved=2ahUKEwiI-4CpnrHpAhVOwKQKHePjCG8Q6AEwBXoECCkQAQ#v=onepage&q=the%20consequence%20of%20motorization%20on%20walking%20and%20cycling&f=false [Accessed 20/05/2020].

Gühnemann, A. 2016. quick facts on monitoring and evaluation. Brussels: Ch4allenge consortium. Available at: http://www.sump-challenges.eu/file/348/download?token=gUPQECmS [Accessed 20/05/2020].

Hubert, M., Lebrun, K., Huynen, P. and Dobruszkes, F., 2016. Daily mobility in Brussels: challenges, tools and priority undertakings. *Brussels Studies*, 10.4000/brussels.1188 Available at: http://journals.openedition.org/brussels/1188 [Accessed 27/04/2020].

Hubert, M., Lebrun, K., Huynen, P. and Dobruszkes, F., 2013. Daily mobility in Brussels: challenges, tools and priority undertakings. *Brussels Studies*, 10.4000/brussels.1188 Available at: https://journals.openedition.org/brussels/1186 [Accessed 20/05/2020].

Hunkin, S. and Krell, K., 2019. Promoting Active Modes of Transport. Brussels: interreg europe. Available at: https://www.interregeurope.eu/fileadmin/user_upload/plp_uploads/policy_briefs/TO4_PolicyBrief_Active_Modes.pdf [Accessed 07/06/2020].

Kengera, Z. 2018. Monitoring and evaluation principles and theories . UNIVERSITY OF DAR ES SALAAM: Available at: https://www.slideshare.net/commochally/monotoring-and-evaluation-principles-and-theories .

Knoflacher, H. 2007. Success and failures in urban transport planning in Europe—understanding the transport system. *Sadhana*, 32(4), pp.293-307. 10.1007/s12046-007-0026-6 Available at: http://www.reconnectingamerica.org/assets/Uploads/knoflachertransportsuccessfailure.pdf [Accessed 09/08/2020].

Lindenau, M., Böhler-Baedeker, S. and Consult, R., 2016. CH4LLENGE Participation Manual: Actively engaging citizens and stakeholders in the development of Sustainable Urban Mobility Plans. Brussels: European Commission. Available at: https://www.ubc-sustainable.net/sites/www.ubc-environment.net/files/publications/sump-manual_participation_en.pdf [Accessed 20/05/2020].

Mackett, R.L. 2012. Reducing Car Use in Urban Areas. In: Anthony D. May, Masanobu Kii and Haixiao Pan. Sustainable Transport for Chinese Cities. Bingley: Emerald Group Publishing Limited. pp.211-230. 10.1108/S2044-9941(2012)0000003012 Available at: https://www.emerald.com/insight/content/doi/10.1108/S2044-9941(2012)0000003012/full/html [Accessed 22/08/2020].

Maple Tech. International, L. 2019. Sample Size Calculator. Available at: https://www.calculator.net/sample-size-calculator.html?type=1&cl=95&ci=6.81&pp=20&ps=200&x=0&y=0 [Accessed 07/06/].

Marsden, G., Docherty, I. and Ochieng, W., 2019. A time of unprecedented change in the transport system. London: Government Office for Science. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/780868/future_of_mobility_final.pdf [Accessed 20/05/2020].

Mobiel21. 2016. Making public transport work better for everyone. Brussels: Available at: http://civitas.eu/sites/default/files/interactions/160215_civitas_capital_insight_making_public_transport_work_better_for_everyone.docx#:~:text=To%20make%20public%20transport%20services,transport%20network%2C%20modernising%20the%20infrastructure%20(.

Neamţu, B. 2011. A Methodology for Assessing how Master Plans Contribute Toward Acheiving Sustainable Urban Development. *Transylvanian Review of Administrative Sciences*, Available at: https://www.openaire.eu/search/publication?articleId=doajarticles::d9327a42d4f25e6c49d3e4be9b589393 [Accessed 22/08/2020].

Nello-Deakin, S. 2019. Is there such a thing as a 'fair' distribution of road space? *Journal of Urban Design*, 24(5), pp.698-714. 10.1080/13574809.2019.1592664 Available at: https://search.datacite.org/works/10.1080/13574809.2019.1592664 [Accessed 22/08/2020].

Pastori, E., Brambilla, M., Maffii, S., Vergnani, R. et al., 2018. Modal shift in European transport. Brussels: European Parliament. Available at: https://op.europa.eu/publication/manifestation_identifier/PUB_QA0518105ENC [Accessed 22/08/2020].

Patapas, A. 2014. New Public Governance: The Tracks of Changes. *International Journal of Business and Social Research*, 4(5), pp.25-32. 10.18533/ijbsr.v4i5.478 Available at: https://www.openaire.eu/search/publication?articleId=doajarticles::1411b0b6dfcbd3dbbe2c4003f47207b9 [Accessed 20/05/2020].

pro.vélo. 2019. Audit ByPad . Available at: https://www.provelo.org/fr/page/en-savoir--sur-le-bypad [Accessed 22/08/].

pro.vélo. 2018. Rapport d'activités 2018 . Available at: https://www.provelo.org/fr/page/2018-a-ete-une-annee-pleine-de-realisations-pour-les [Accessed 22/08/].

Pro.vélo. 2017. Observatoire du vélo en Région de Bruxelles-Capitale 2017. Available at: https://www.provelo.org/fr/page/observatoire-bruxelles-2017 [Accessed 22/08/].

pro.vélo. 2016. Observatoire du vélo en Région de Bruxelles-Capitale 2016 . Available at: https://www.provelo.org/fr/page/observatoire-du-velo-en-region-de-bruxelles-capitale [Accessed 22/08/].

Rakić, J.Z., Mirić, A.A., Marić, S., Lazarević, M. et al., 2014. manual for monitoring & evaluation of public administration reform policy. Belgrade: Foundation for the Advancement of Economics European Policy Centre. Available at: http://www.cep.org.rs/images/me_studija/prirucnici/manual_state_final_eng.pdf [Accessed 20/05/2020].

Reed, M.S., Vella, S., Challies, E., de Vente, J. et al., 2018. A theory of participation: what makes stakeholder and public engagement in environmental management work? *Restoration Ecology*, 26(S1), pp.S7-S17. 10.1111/rec.12541 Available at: https://search.datacite.org/works/10.1111/rec.12541 [Accessed 20/05/2020].

Rodrigue, J., Comtois, C. and Slack, B., 2016. The Geography of Transport Systems. London: Taylor & Francis Group. https://doi.org/10.4324/9781315618159-10 Available at: https://ebookcentral.proquest.com/lib/[SITE_ID]/detail.action?docID=4771887 [Accessed 22/08/2020].

Scott Toscano. 2013. Exploring the History and Challenges of Monitoring and Evaluation in International Nongovernmental Organizations. Vermont: SIT Graduate Institute. Available at: https://digitalcollections.sit.edu/cgi/viewcontent.cgi?referer=https://www.google.com/&httpsredir=1&article=3650&context=capstones [Accessed 20/05/2020].

Smart Cities Editorial. 2018. A revolution in urban mobility? It's on the way – and just in time. Available at: https://eu-smartcities.eu/news/revolution-urban-mobility-its-way-and-just-time [Accessed 06/05/].

STIB-MIVB. 2018. Activity report 2018. Brussels: STIB-MIVB. Available at: http://2018.stib-activityreports.brussels/en [Accessed 22/08/2020].

STIB-MIVB. 2017. Activity report 2017. Brussels: STIB-MIVB. Available at: http://2017.stib-activityreports.brussels/en [Accessed 22/08/2020].

STIB-MIVB. 2010. Figures & statistics 2010. Brussels: STIB-MIVB. Available at: http://www.stib-mivb.be/irj/go/km/docs/STIB-MIVB/INTERNET/attachments/Statistiques/2010/STIB_Statistique_A4_EN_def.pdf [Accessed 22/08/2020].

STIB-MIVB. La STIB d'hier à aujourd'hui. Available at: https://www.stib-mivb.be/article.html?_guid=c064a3c8-3983-3410-8d8c-c79a956f6a05&l=fr [Accessed 22/08/].

Thiry, C. and Bruxelles Mobilité, 2011. IRIS II Plan de mobilité Région de Bruxelles Capitale. Brussels: Bruxelles Mobilité,. Available at: http://www.avcb-vsgb.be/documents/File/IRIS%202%20Plan%20de%20mob%20RBC.pdf [Accessed 27/04/2020].

Tsay, S. and Herrmann, V., 2013. Rethinking Urban Mobility: Sustainable Policies for the Century of the City. Massachusetts: Carnegie Endowment for International Peace. Available at: http://gateway.proquest.com/openurl?url_ver=Z39.88-2004&res_dat=xri:policyfile&rft_dat=xri:policyfile:article:00159313 [Accessed 22/08/2020].

United Nations Human Settlements Programme. 2013. Planning and Design for Sustainable Urban Mobility. London: Routledge Ltd. 10.4324/9781315857152 Available at: https://www.taylorfrancis.com/books/9781317932871 [Accessed 20/05/2020].

van Thiel, S. 2014. Research Methods in Public Administration and Public Management. London: Routledge. 10.4324/9780203078525 Available at: https://www.taylorfrancis.com/books/9780203078525 [Accessed 20/05/2020].

Whitmarsh, L. 2012. How useful is the Multi-Level Perspective for transport and sustainability research? *Journal of Transport Geography*, 24pp.483-487. 10.1016/j.jtrangeo.2012.01.022 Available at: http://dx.doi.org/10.1016/j.jtrangeo.2012.01.022 [Accessed 20/05/2020].

World Bank Group. 2017. why urban transport matters. Available at: https://ieg.worldbankgroup.org/evaluations/urban-transport [Accessed 27/04/].

Annex 1: Research Instruments

Questionnaire

Good Morning/ Good Afternoon. My name is Paul, I am a master's student at the Institute of Housing and Urban Development Studies in Rotterdam. As part of my thesis I am conducting research on urban mobility in Brussels. I would like to share with you a written questionnaire about the impacts of the IRIS II plan, as well as the factors that influenced it. Would you have 10-15 minutes to answer some questions?
I would like to gather some perspectives and information related to the development and implementation of the 'IRIS II regional mobility plan' spanning from 2010-2018. Before we start the interview, this questionnaire is voluntary. If you do want to skip a question or interrupt the whole interview, feel free to tell me at any time.

Can we continue?
*[if the person answers **NO**]*
No problem. Your phone number will be deleted from our system. Thanks for your attention!
[end interview]

*[if person answers **YES**]*
Thanks a lot. We'll now move on to the initial screening question before we begin the interview.
[go to screening questions]

Questions	Answer
0.1 Do you confirm live in the BCR? (a) yes (b) no	Single answer
0.2 How old are you? - 0 – 18 - 18 – 36 - 36 – 54 - 54 – 72 - 72 – 90	Years
0.3 What's your gender? (a) male (b) female (c) other	Single answer

Development of modal alternatives

3.1 Do you find there was sufficient investment in mobility infrastructure to provide adequate access to opportunities and improve the quality of life? (a) Yes (go to question 3.2) (b) No	Open answer

3.2 Do you find the investments in mobility infrastructure promoted multimodal solutions at schools and businesses? - Yes - no - I do not know	Multiple answers

Let's move to the section related with sidewalks, roads and public infrastructure

8.1 Do you find the provided infrastructure (cycling lanes, sidewalks and public transport infrastructure) was safe and user friendly? (a) Yes, in good condition (b) No, in bad condition (c) Other [write answer] _____	Single answer
8.2 Do you believe the quality of the infrastructure contributed to the promotion of a modal shift? (a) Yes. (b) No. (c) Yes, though other factors also played a role. *[skip to question 8.3.]* (d) No, other factors were the main factor. *[skip to question 8.3.]*	Single answer
8.3 Please mention the factors? [write answer] _____	open answer

Let's move to the modal shift

9.1 Do you believe the actions undertaken during the IRIS II plan increased the network length of public transportation? (a) yes *[proceed to question 9.1.a.]* (b) no [end questionnaire) (c) I don't know	Open answer
9.2 Do you find the actions undertaken in the IRIS II plan improved the frequency and speed of transit of public transport? - Yes - No - I do not know	Open answer
9.6 Do you have any final comments?	Open answer

Thank you for your participation. This information will be very useful and helpful to my research. If you want to receive the results, please let me know your email and I can share them with you. The thesis will be submitted to the school and a copy will be deposited in the IHS library.

Interview Guide

Good Morning/ Good Afternoon. My name is Paul Préaux, currently a master's student at Institute of Housing and Urban Development Studies in Rotterdam. I'm looking into the various factors that influenced the promotion of a modal shift by development the modal alternatives, as stated in the IRIS II regional mobility plan of BCR. I would like to conduct a telephone/zoom/skype interview. Would you have 20-30 minutes to answer some questions.

I would like to gather some perspectives and information related to the development and implementation of the 'IRIS II regional mobility plan' spanning from 2010-2018. Before we start the interview, this questionnaire is voluntary. If you do want to skip a question or interrupt the whole interview, feel free to tell me at any time.

Can we continue?
*[if the person answers **NO**]*
No problem. Your phone number will be deleted from our system. Thanks for your attention!
[end interview]

*[if person answers **YES**]*
Thanks a lot. We'll now move on to the initial screening question before we begin the interview.
[go to screening questions].
Kindly allow me to record these proceedings for research propose only.

Questions	Answer
0.1 Do you confirm live in the BCR? (a) yes (b) no	Single answer
0.2 How old are you? - 0 – 18 - 18 – 36 - 36 – 54 - 54 – 72 - 72 – 90	Years
0.3 What's your gender? (a) male (b) female (c) other	Single answer

Thank you, we'll now move on to case specific questions.

1. Please state your name: _____	Open answer
1.1 Were you actively involved in the development and/or implementation of the IRIS II plan? (a) yes *[proceed to question 1.1.a.]* (b) *no [end questionnaire]*	Single answer

1.1a Who do you represent today? *(a)* [write answer] _____	Open answer
1.2 Which of the following best describes the role of your organisation/institutions? (a) Local stakeholder (local business, organization, school, NGO etc.) [if so, please provide name] _____ (b) Active citizen (c) Political representative of municipality [if so, please give a postalcode] _____ (d) Political representative of region [if so, please provide the section] _____	Single answer
1.3 When did you get involved in the process? (a) 2010 - 2012 (b) 2012 - 2014 (c) 2014 - 2016 (d) 2016 - 2018	Single answer
1.5 When did you stop being involved in the process? (a) 2010 - 2012 (b) 2012 - 2014 (c) 2014 - 2016 (d) 2016 - 2018	Single answer
1.5 How would you rate your experience in working on mobility matters with the Region? (a) very good (b) good/ (c) fair (d) bad (e) terrible	

Institutional cooperation

3.1 Did you find there was sufficient sharing of knowledge and resources to foster mutual understanding and cooperation between actors? Yes or no, please elaborate on this: _____	Open answer
3.2 Do you find the regional leadership enhanced a culture of cooperation? Please elaborate on this. [write answer] _____	Open answer
3.2 Which and why were the main sources of frustration within the context of institutional cooperation? (a) Regional authorities (b) Municipal authorities (c) Other stakeholders and citizens (d) Inconsistency in the consultation process *[skip to question 3.2.a]* (e) Lack of support *[skip to question 3.2.a]* (f) other. Which condition? [write answer] _____ (g) none	Multiple answers
3.2.a If possible, please elaborate on this: [write answer, max 1 sentence] _____	Multiple answer
Can you share anything about the diversity of actors present during meetings?	

Stakeholder and citizen consultation

3.1 Did you find there was sufficient consultation from civil society to increase transparency and respond to the wishes of citizens? (a) Yes (go to question 3.2) (b) No	Open answer
3.2 If yes, can you elaborate on the channels of dialogue established within this goal (i.e workshops, meetings, etc)? [write answer] _____	Open answer
3.3 Can you share anything about the diversity of stakeholders and citizens consulted during the consultation process? Klassiek gemmente mivb	Multiple answers
3.2 Which level of authority was most involved in the civil consultation process? (a) Regional authorities (b) Municipal authorities (c) Other stakeholders and citizen organizations	Multiple answer

Consultation process

2.1 How often were citizens consulted for the consultation process? (a) Every day (b) Once a week (c) Every other week (d) Once a month (e) Every few months (max. 3months) (f) A few times a year (g) ntOnce a year (h) One time	Single answer
2.2 How and what type of consultations happened during your involvement? (a) Physically participated in consultation meetings; (b) Other. Please specify [write answer] _____	Single answer
2.2 Please share your experiences about this process [write answer] _____	Single answer

Monitoring and evaluation

3.1 Do you find the modal shift targets were well formulated? (d) Yes (go to question 3.2) (e) No	Open answer
3.2 If no, can you elaborate on how they lacked? [write answer] _____	Open answer

3.2 Are you aware of the monitoring and evaluation activities? Yes no? _____	Multiple answers
Can you elaborate on the quality of these activities?	Multiple answer
Can you share anything about the frequency of monitoring and number of final evaluations?	Open answer
3.3 Which level of authority was most involved in the monitoring and evaluation process? (c) Regional authorities (d) Municipal authorities Other stakeholders and citizen organizations	

Development of modal alternatives

3.1 Do you find there was sufficient investment in mobility infrastructure to provide adequate access to opportunities and improve the quality of life? (e) Yes (go to question 3.2) (f) No	Open answer
3.2 If no, can you elaborate on where there lacked investment? [write answer] _____	Open answer
3.2 Do you find the investments in mobility infrastructure promoted integrated and innovative solutions for modal alternatives? Yes no? Yes? Can you elaborate on the quality of these activities? (g) _____	Multiple answers
3.3 Which level of authority was most involved in these developments? (h) Regional authorities (i) Municipal authorities (a) Other stakeholders and citizen organizations	Multiple answer

Let's move to the section related with sidewalks, roads and public infrastructure

8.1 Do you find the provided infrastructure (cycling lanes, sidewalks and public transport infrastructure) was safe and user friendly? (d) Yes, in good condition (e) No, in bad condition (f) Other [write answer] _____	Single answer
8.2 Do you believe the quality of the infrastructure contributed to the promotion of a modal shift? (e) Yes. (f) No. (g) Yes, though other factors also played a role. *[skip to question 8.3.]* (h) No, other factors were the main factor. *[skip to question 8.3.]*	Single answer

8.3 Please mention the factors? [write answer] _____	open answer

Let's move to the modal shift

9.1 Do you believe the actions undertaken during the IRIS II plan increased the network length of public transportation? (d) yes *[proceed to question 9.1.a.]* (e) no [end questionnaire) (f) I do not know	Open answer
9.2 Do you find the actions undertaken in the IRIS II plan improved the frequency and speed of transit of public transport? - Yes - No - I do not know	Open answer
9.3. Do you find the actions undertaken in the IRIS II plan improved the accessibility of active modal alternatives? [write answer] _____	Open answer
9.4 Can you share anything about in what way this network size was increased?	Open answer
9.5 Was there a change in fiscal incentives for car ownership in BCR?	Open answer
9.6 What can you share about this process?	Open answer

If you do not have any other comments or questions, this was it, we have come to the end of the interview. I would like to thank you so much for your insights and participation. I would like also to ask, if possible, to share any relevant documents regarding the plan that I can include on my research.

I will transcribe the interview and code all the data collected to be prepared for analysis in order to answer the research question. This information will be very useful and helpful to my research. If you want to receive results from my research, please share with me know your email and I can it share with you and/or your organization. The thesis will be submitted to the school and a copy will be deposited in the IHS library.

Annex 2: Questionnaire respondent characteristics

Sample Group	Number of respondents
Man	**39**
0/18	1
18/36	10
36/54	10
54/72	14
72/90	4
other_	**1**
18/36	1
Woman	**47**
0/18	3
18/36	11
36/54	19
54/72	13
72/90	1
Grand Total	**87**

Sample Group	Count of participation
Man	**39**
No	17
Yes	22
other_	**1**
No	1
Woman	**47**
No	29
Yes	18
.	
.	
Grand Total	**87**

Sample Group	Count of Residents
Man	**39**
No	4
Yes	35
other_	**1**
Yes	1
Woman	**47**
No	4
Yes	43
.	
(blank)	
Grand Total	**87**

Are you a BCR resident?	What is your age range?	What is your sex?	Did you participate	Who do you represent?
Yes	54/72	Woman	No	NMBS
Yes	54/72	Man	Yes	Commune_de_Woluwe-Saint-Pierre
Yes	36/54	Woman	No	particulier
Yes	36/54	Man	Yes	OVK-SAVE
Yes	18/36	Woman	No	BRAL
Yes	54/72	Man	Yes	sncb
Yes	36/54	Man	No	administration auderghem_collectif_1030/0
Yes	54/72	Man	No	Moi
No	54/72	Man	No	Navetteurs_Bruxelles
Yes	54/72	Man	No	Taxi
Yes	36/54	Woman	No	Moi_même_
Yes	54/72	Woman	No	administration regionale_
Yes	18/36	Man	No	Paul_
Yes	36/54	Woman	No	administration regionale
Yes	54/72	Man	Yes	commune_
Yes	36/54	Woman	No	administratie schaerbeek
Yes	36/54	Man	Yes	sauver_les_enfants_asbl
Yes	18/36	Woman	No	urban_platforms
Yes	54/72	Man	Yes	nmbs
Yes	36/54	Man	No	1030/0
Yes	54/72	Woman	No	administratie jette
No	54/72	Woman	No	navetteurs_de_bruxelles
Yes	54/72	Man	Yes	taxibond
Yes	36/54	Woman	No	mezelf
Yes	54/72	Woman	No	administratie jette
Yes	18/36	Man	Yes	stib
Yes	36/54	Woman	No	administration jette
Yes	54/72	Woman	Yes	commune
Yes	54/72	Man	Yes	region
Yes	36/54	Woman	Yes	administration schaerbeek
Yes	36/54	Woman	Yes	administratie etterbeek
Yes	36/54	Man	Yes	change_colignon
Yes	54/72	Woman	Yes	schaerbeek
Yes	18/36	Woman	No	personne
Yes	18/36	Woman	Yes	platforme_URBAINE
Yes	36/54	Man	Yes	tec
Yes	72/90	Woman	Yes	delijn
Yes	54/72	Man	Yes	stib
Yes	72/90	Man	No	administration jette
Yes	36/54	Man	Yes	sncb-_le_train
Yes	36/54	Woman	yes	administration jette
Yes	18/36	Man	No	Commune de schaerbeek
Yes	0/18	Woman	Yes	gewestelijke_mobiliteitscommissie_mivb
Yes	36/54	Woman	Yes	Commission_Régionale_de_la_Mobilité-STIB
Yes	54/72	Woman	Yes	Commission_Régionale_de_la_Mobilité-SNCB
Yes	36/54	Man	Yes	administration regionale
Yes	0/18	Man	No	actieve_administration schaerbeek_en_automobilist_
Yes	18/36	Woman	Yes	fietser_en_administration schaerbeek

Yes	18/36	Woman	No	administratie etterbeek_
No	54/72	Man	Yes	administratie etterbeek_travaillant_à_bruxelles
Yes	0/18	Woman	No	les_cyclistes
Yes	36/54	Woman	No	les_bruxellois_taxis_
Yes	36/54	Man	No	taxis
Yes	54/72	Woman	No	commune_de_etterbeek
Yes	18/36	Man	Yes	Commission_Régionale_de_la_Mobilité
Yes	36/54	Woman	Yes	stib/_de_bruxelles
Yes	54/72	Woman	No	personne
Yes	18/36	other_	No	la_communaute_lgbtq
Yes	36/54	Woman	No	schepen_van_st_gillis_
Yes	36/54	Man	No	taxis_de_bruxelles_-_taxivert
No	18/36	Man	No	bewoners_uit_vlaamse_rand_
No	36/54	Woman	No	pendelaars_naar_de_stad_
Yes	36/54	Woman	No	BECI
No	18/36	Woman	No	mezelf_
Yes	18/36	Woman	Yes	BECI
Yes	18/36	Man	No	schdpen_uit_evere_
Yes	0/18	Woman	No	BECI
Yes	18/36	Woman	No	ikzelf_
No	18/36	Man	No	niemand
Yes	72/90	Man	Yes	Commission_Régionale_de_la_Mobilité
Yes	72/90	Man	Yes	Commission_Régionale_de_la_Mobilité
Yes	72/90	Man	Yes	Commission_Régionale_de_la_Mobilité
Yes	54/72	Man	Yes	gewestelijke_mobiliteits_commissie_
Yes	54/72	Woman	Yes	gewestelijke_mobiliteitscommissie_
Yes	36/54	Woman	No	Gluon_vzw_
Yes	18/36	Man	Yes	beci
No	54/72	Woman	Yes	stib
Yes	36/54	Woman	No	helmet_asbl
Yes	36/54	Woman	Yes	actieve_administration schaerbeek_uit_brussel_stad_
Yes	18/36	Woman	No	administratie etterbeek
Yes	54/72	Man	No	personne_
Yes	18/36	Man	No	/
Yes	18/36	Woman	Yes	villo_
Yes	54/72	Woman	Yes	jcd_decaux_
Yes	54/72	Man	Yes	la_region_
Yes	36/54	Woman	No	Moi_même
Yes	18/36	Man	No	STIB

Inter-Item correlation matrix 1

	Network Length (public transportation) and modal shift
Correlation coefficient (r)	0.217
P-value	0.085

Annex 3: List of boxes with summary of quotations per indicator

Box 1: Summary of quotation for implementation of actions

Indicator	Question(s)	Response(s)
Implementation of actions	Do you find the regional leadership enhanced a culture of cooperation?	R1: […] we lacked executive powers, this caused delays in the implementation as the regional actor (Brussels Mobility) would need to hire third parties for the implementation of actions along regional roads." Until 2013, we also lacked regulatory power and could not force anyone to implement an action. With state reform I pushed for more autonomy for the region, this helped us accelerate the development of our own ambitions. R3: […] the regional authorities needed cooperation from municipalities and cause the cycling infrastructure to randomly stop because of a lack of cooperation. Sometimes this was because the municipality preferred another street for a new cycling path, even though they promised that they would develop in another street. R5: because before the state reform the region relied on financing from the federal government the region was often underfinanced, this had disastrous impacts on the region and we did not have leadership to develop our mobility ambitions due to lack of funds. […] The state reform allowed us to change the plan to a regulatory plan and enabled us to move away from voluntary cooperation and use enforcement mechanisms instead. But the election of Pascal Smet, with his Brussels for People agenda, was, for me, the most defining factor that accelerated the development ambitions due to political motivation.
Implementation of actions	Do you find there was sufficient investment in mobility infrastructure to provide adequate access to opportunities and improve the quality of life?	R2: the development of municipal cycling lanes was slowed down and the infrastructure was often not continuous as it could cross a regional road, where the cycling lane would be interrupted[…] Many of the municipalities on this side of the canal opposed some of the proposed actions[…] The unwillingness to modify the region's proposals led to polarization between the municipalities and region, this led to years of delays for the renovation of the Koekelberg tunnel.

	Do you find the provided infrastructure (cycling lanes, sidewalks and public transport infrastructure) was safe and conformed to the quality requirements?	R4: the pedestrian and cyclist infrastructure lacked in quality; in some places it did not conform to regional norms. The materials used would often change, this contradicted the promise to provide accessible-for-all infrastructure. We were only consulted when developments needed to be made, this led to antagonism and a lack of cooperation from our side to ensure that our demands were heard.

Box 2: Summary of quotation for implementation of actions

Indicator	Question(s)	Response(s)
Network length (public transportation)	Do you believe the actions undertaken during the IRIS II plan increased the network length of public transportation?	R6: […] but for trams, busses and metro some developments were achieved. The busses and metro did not really change much, apart for the development of bus line 33 in the city center and maybe a new bus stop here and there, but the tram did improve. I think three tramlines were developed and another one was extended; this benefitted the north eastern part of the city.

Box 3: Summary of quotation frequency and speed of transit

Indicator	Question(s)	Response(s)
Frequency and speed of transit (public transportation)	Do you find the actions undertaken in the IRIS II plan improved the frequency and speed of transit of public transport?	R1: the MIVB/STIB informed us that if we provided them with a separate bedding, the frequency and transit speed could be increased by as much as 20%, without incurring extra costs for the company. When possible, we implemented this, and we saw that the both factors improved following these developments, though this was limited to the places where this was possible. R5: data from the MIVB/STIB indicates that the transit speed, and frequency, has actually decreased between 2010 and 2018. We don't know why this is, we noted an increased frequency and transitspeed for major busses and trams. We do believe the actions implemented made public transportation a more viable and attractive alternative for some people. R6: Yes, in our municipality we saw improvements of public transportation. The new tram line was much more efficient, the frequency and transit speed of these trams is unhindered by other road users as they have their own bedding along the main avenue. R8: […] the regional mobility commission of Brussels had previously proposed to provide a separate bedding for busses and trams, though most trams alreadt benefitted from this. We really pushed for this and it was adopted since the start of the plan's implementation, we saw frequency and transit speed improve on the roads where it was implemented, busses mainly benefitted from not being stuck in traffic anymore. We similarly proposed to provide smart traffic lights, this also had a positive effect on busses and trams.

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