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DOI
10.1016/j.tranpol.2025.02.007

Publication date
2025

Document Version
Final published version

Published in
Transport Policy

Transport Policy 165 (2025) 1–16

Contents lists available at ScienceDirect

Transport Policy

journal homepage: www.elsevier.com/locate/tranpol

A framework of success factors and barriers for urban car reduction in European cities

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ARTICLE INFO

Keywords:
Car-reducing policies
Low-car
Policy design
Cross-case analysis
Success factors
Barriers

ABSTRACT

Cars and roads have helped create modern society. However, their use comes at a cost for cities and their residents, in particular with respect to liveability. To improve liveability, cities are implementing a wide range of measures. This paper addresses the challenges cities face in reducing urban car dependency and provides lessons from their experiences. Major research gaps exist around governance questions regarding real-world policy development to aid in the transition towards sustainable mobility.

Case studies in cities with comparable population sizes and experience in car-reducing measures, namely Copenhagen, Barcelona, Bremen, and Milan, provide new insights for policymaking, all to understand the context in which a policy can flourish and help policymakers make them more successful. These insights lead to a framework of success factors and barriers based on theory and practice for other policy makers to use.

Eight different success factors have been identified to overcome the five barriers and successfully implement their policies. Six originate from the literature and were confirmed in the case studies. The two final success factors of 'the inarguability of schools' and 'the undeniability of hard evidence', emerged from the cases.

In the cases interviewees identified and prioritised the links between these factors and barriers, and how the success factors can reduce the barriers. This research adds to the literature of real-world policy examples and includes issues of governance that policymakers may run into. The novelty is in the framework of success factors and barriers, based on the experiences of Western European cities with a comparable population size. The framework can be used by both policymakers and researchers to design and compare car-reducing policies.

1. Introduction

The car has played a major role in shaping modern Western societies (Gilroy, 2001), has provided the highest mobility share and has brought increased mobility and economic prosperity (Khreis et al., 2016). However, it has become ever clearer that extensive car usage comes at a cost for cities and their residents, especially with respect to what is generally referred to as liveability. The challenge for governments is to balance liveability and accessibility. Reducing the number of cars is a means to achieve liveability goals, such as climate change reduction (European Environment Agency, 2023, 2024; Intergovernmental Panel on Climate Change (IPCC), 2023) air quality (European Environment Agency, 2022; Sicard et al., 2021; Tan et al., 2023; World Health Organization, 2022) improved living space (Fritschi et al., 2011; Helbich et al., 2018; Khreis et al., 2016; Lee and Maheswaran, 2011; Maffei and Masullo, 2014), health and safety (Blair, 2009; European Commission, 2020; Mueller et al., 2015; World Health Organization, 2018), and may reduce societal cost (European Court of Auditors, 2019; Gössling et al., 2022; van Essen, 2018). To achieve these goals, local governments are promoting the design of healthier environments based on a wider approach in which mobility-related actions play a pivotal role (Camerin and Longato, 2024).

Filling the research gaps on why policies are chosen, how and why they are framed as they are, and how they survive with competing priorities, can aid policymakers in designing and implementing transitions toward sustainable mobility (Marsden and Reardon, 2017; Nikulina et al., 2019). Real-world policy-making experiences and their context can provide valuable insights, that are currently lacking in the literature.

This paper focuses on these knowledge gaps and explores why and how specific car-reducing policy measures have been implemented in different middle-sized Western European cities, including aspects of framing and competing interests.

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https://doi.org/10.1016/j.tranpol.2025.02.007
Received 3 November 2024; Received in revised form 22 January 2025; Accepted 3 February 2025
Available online 7 February 2025

2. Method

This paper uses a cross-case analysis of the implementation of car-reducing measures to determine the experienced success factors and barriers. Using an initial framework with success factors identified by Sørensen et al. (2014) and barriers by Maat and Louw (1991), document analysis and interviews with key stakeholders from four larger-sized Western European cities[1] were carried out. These reveal the relative importance of factors from the literature as well as other factors that influenced the implementation of car-reducing policies. Based on a report on 22 car-reducing measures by one of the authors of this paper, 31 cities with significant experience in implementing these measures were selected through Google Scholar, local, national and supranational governments and reputable news sources.

From these 31 cities, nine were selected with comparable population size and notable experience with a measure. These nine cities were asked to participate in this study through email. Four cities responded positively. These cities are Barcelona, Bremen, Copenhagen and Milan. The selection process is visualised in Fig. 1. For each city, semi-structured interviews were performed online with three different stakeholders involved in the policymaking process, as shown in Appendix A. The interview protocol (see Appendix A) focuses on the key moments in the implementation process and provides explanations about context, power, resources and legitimacy in governance. All stakeholders reviewed a summary of the results of the interviews.

Multiple interviews provide multiple perspectives for triangulation, an important validity strategy for generalising qualitative case studies to a broader theory (Creswell, 2009). Providing rich and detailed descriptions by including multiple perspectives can transport the reader to the setting, further increasing the validity. Furthermore, exploring the differences, similarities and case-unique factors between cases can help to understand the relationship that connects each case. Though multiple perspectives are included in each case, a limitation lies in the comparable policymaking background of each interviewee. This may cause an underrepresentation of residents and civil society organisations and a bias in the findings.

3. Theory

Literature on transformations towards sustainable mobility and improved liveability provides insights on success factors and barriers for car-reducing measures.

3.1. Transformations

In transformations, the nature of a system is fundamentally changed. According to Lonsdale et al. (2015), A successful transformation requires three capacities. First, the current situation must be understood. Exploring why existing systems operate as they do, given the policy, can provide insights about improvements. Second, policymakers must be willing to invest in long-term goals while maintaining an awareness of the bigger picture. They should also identify challenges and encourage system-wide participation. Third, they must be willing to learn from practice to help create opportunities. Testing in 'real life' can deepen the understanding and participation of people in a system.

3.2. Success factors and barriers

Focusing specifically on road pricing measures, Sørensen et al. (2014) identify six "barrier management strategies" based on practice combined with policy-making theory. These strategies have led to success. The success factors are.

- *Combining sticks and carrots*; Policymakers increase societal acceptance of a measure that is experienced negatively by including measures that are experienced positively.
- *Showing openness and flexibility in negotiations*; Policymakers are open to changes in the implementation to increase acceptability
- *Trials to create legitimacy*; Demonstrating a measure and its effects in a pilot creates experience with a measure.
- *Applying communication strategically*; Carefully considering who, how and what is communicated can change a measure's perception.
- *Timing and windows of opportunity*; A measure can only be implemented when policy, problem and proposal streams align.
- *Organising responsibility and set-up*; A new working unit can help in a measure's implementation.

Looking specifically at transport reduction measures, Maat and Louw (1999) identify four barriers that policymakers experience, comparable to those found by Banister (2004b) that reduce the success of a promising measure. Low and Astle (2009) identify an additional barrier related to risk in transportation planning and decision-making.

- *Policy and institutional barriers*; Different interests of stakeholders can result in conflict.
- *Legal barriers*; Existing legal frameworks can cause difficulty in the measures' implementation.
- *Resource barriers*; A lack of resources, both financial and otherwise, can hinder implementation.
- *Social and cultural barriers*; Low societal acceptance of the measure can result in political resistance.
- *Path dependence*; Lock-in can be created when routines, infrastructure or assumptions cause the existing path to be followed.

These factors all were part of the framework. They were put in a timeline for each of the cases and which in turn were the basis for a systematic cross-case comparison using descriptive theory on policy implementation following Kingdon and Stano (1984).

4. Results

The context of the four cases is essential in the understanding of success factors, barrier, and their interdependencies.

4.1. Context of the selected cities

The context and timeline of the analysed measures are provided for each case, based on the literature and interviews.

4.1.1. Barcelona

In the 1980s, research showed that all through traffic should be removed from Barcelona's neighbourhoods for the city to meet the recommended maximum noise levels. The notion of a Superblock emerged as an area where non-residential through traffic is blocked (Fabris et al., 2020). The first three partial Superblocks were implemented between 1993 and 2003 (Roberts, 2019). It was not until 2015 before the first complete Superblock was built after a supportive Mayor was elected. This Superblock began with a pilot implemented by students from Catalonian architecture schools. Within the Superblock, comfortable living space replaces roads. The pilot initially resulted in significant pushback from residents, nearly ending the project. However, the Deputy Mayor, students and residents in favour of the Superblock persisted and as residents got used to the advantages of the newly created calm areas, acceptance grew (interview Ba2). An illustration of the Superblocks is given in Fig. 2.

[1] The definition of Western Europe used is that of the United Nations voting blocks, due to their comparable socio-economic landscape (United Nations, n. d.). Based on its history with car-reduction, Western Europe is selected. This car-reducing trend is shown in several major Western European cities (Buehler et al., 2017).

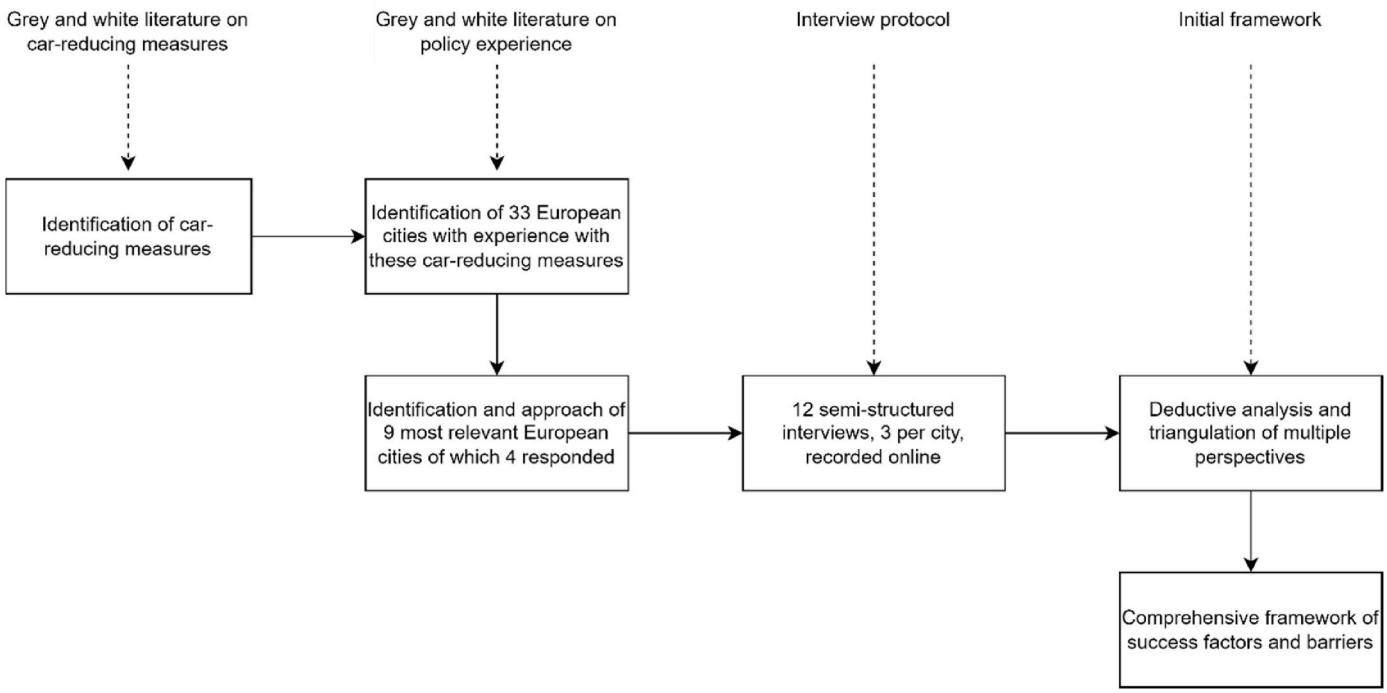

Fig. 1. Research methodology.

Fig. 2. Illustration of Barcelona Superblock road (under Creative Commons license).

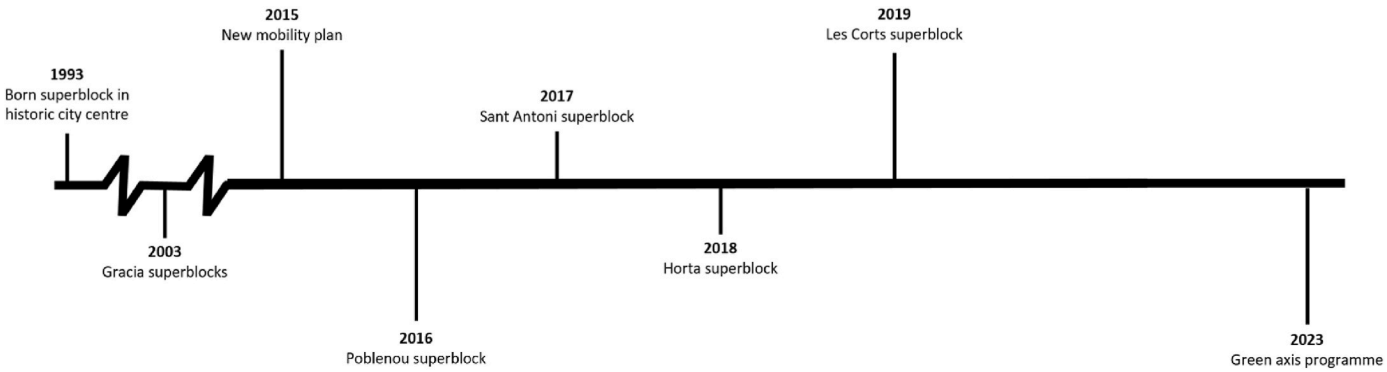

Fig. 3. Timeline superblock Barcelona.

Following the increased number of proponents, Barcelona's Mayor favoured the project and initiated new Superblock pilots. Learning from experience, the neighbourhood participation process was improved. This resulted in more engagement and the pilot's success (interview Ba1).

For the project's next phase, the Superblocks were connected with green axes. On these pedestrian-forward streets, cars are required to give way to pedestrians. This slows down traffic throughout the city, benefitting residents throughout the city. However, the newly elected government opposed the project and has started reversing the progress (interview Ba2). The timeline is shown in Fig. 3.

4.1.2. Bremen

In 1990, a group of citizens were granted funding from the Municipality to begin a car club to provide an alternative to privately owned cars. After facing some political resistance, the Municipality introduced a nationwide label to classify good car sharing (interview Br1). In 2003, the Municipality built the first on-street stations that were named pilots (interview Br3). With an evaluation showing positive effects, Bremen passed its car-sharing plan in 2009 to significantly increase the number of users and started building a dense network of stations (interview Br2). An impression is shown in Fig. 4.

After 12 years, a national car-sharing law passed, providing the Municipality with a strong legal foundation so the stations were no longer considered pilots (interview Br1). The timeline is depicted in Fig. 5.

4.1.3. Copenhagen

In 2008, the potential for a long-distance bicycle network around Copenhagen was proven and in 2009 Copenhagen announced the goal of having 50% of its commuter traffic by bicycle. The main goal was to reduce congestion and air pollution. Due to an organisational reform, municipalities became responsible for their bicycle paths and there was no central organisation. Copenhagen joined forces with 16 municipalities and the Capital Region to develop an annual cycling collaboration. In 2012, the Office for Cycle Superhighways launched its first cycle superhighway. The cycle highways were planned as corridors between work and residential areas where commuters cycle for the largest part of their journey on the cycle highways and find other roads for the remainder of their commute (interview Co1).

Development of the routes continued and in 2017, 8 routes proposed by municipalities were built. An impression is shown in Fig. 6. A report in 2018 showed the positive effects of the Cycle Superhighways in reduced sick days and emissions. Challenges lie in the coordination between participating municipalities and collecting the required funding to maintain the preferred quality standards. As the collaboration is reviewed annually, funding and commitment are frequently renewed and support is uncertain (interview Co2). Fig. 7 shows the timeline.

4.1.4. Milan

Following the decades of car-centric design where public space was traded for roads and parking spaces, the Mayor of Milan launched the Piazze Aperte initiative in 2018 (Bartling, 2023) and the Strade Aperte initiative in 2020 (Nalmpantis et al., 2021). Using paint and planters, benches and ping-pong tables, public space was reclaimed in the Piazze Aperte programme. The goal was to bring urban spaces back into public life, improve safety, encourage collaboration between residents and implement low-cost transformations before addressing permanent interventions (Comune di Milano, 2022). After the first 15 pilots were implemented, a design process and toolkit were developed to support citizens in their new central role (interview Mi1). Two of the pilots were made permanent later (Alberti and Radicchi, 2022). An example of a transformed square is shown Fig. 8.

In 2019, a new programme was launched in which citizens identified new locations for transformations. The 65 proposals were analysed, refined and developed in collaboration with residents using fast and cheap materials, resulting in 40 interventions by 2022 (Alberti and Radicchi, 2022; Huang, 2023). The third phase focused on school communities. Of the 87 received proposals, the Municipality plans to implement at least 30 projects in the coming years (interview Mi1). The Municipality supplies materials and periodic cleaning. Citizens organise events and everyday management (Maletti, 2020). Following the tactical design, the interventions need to be made permanent. So far, this has happened to six transformations and another four will follow this year (interview Mi1). The timeline is shown in Fig. 9.

During the COVID-19 pandemic, the plan to implement emergency cycling-related measures for post-pandemic mobility was launched to address the concern that travellers would be hesitant to return to public transport after the pandemic due to viral transmissions. Bicycles and scooters could provide an alternative to private automobiles. Milan officials implemented experiments without public consultations and addressed the pushback by arguing that the infrastructure could be reversed if necessary. The plan converted roads into bicycle paths and pedestrian areas and expanded the 30 km/h zone (Bartling, 2023). Transformations are selected based on accident data and regular checks are performed to confirm that the transformation has increased the safety (interview Mi2).

4.2. Success factors

The success factors identified in the literature in Section 3.2 are discussed in relation to the cases.

Fig. 4. Illustration of the carsharing stations in Bremen (under Creative Commons License).

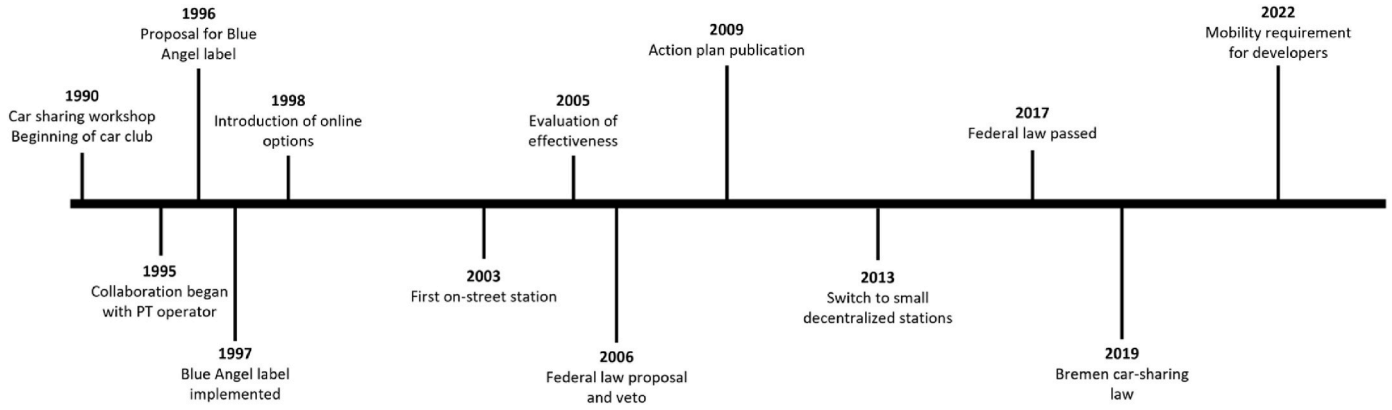

Fig. 5. Timeline shared cars Bremen.

Fig. 6. Impression of Copenhagen Cycle superhighway (under creative commons license).

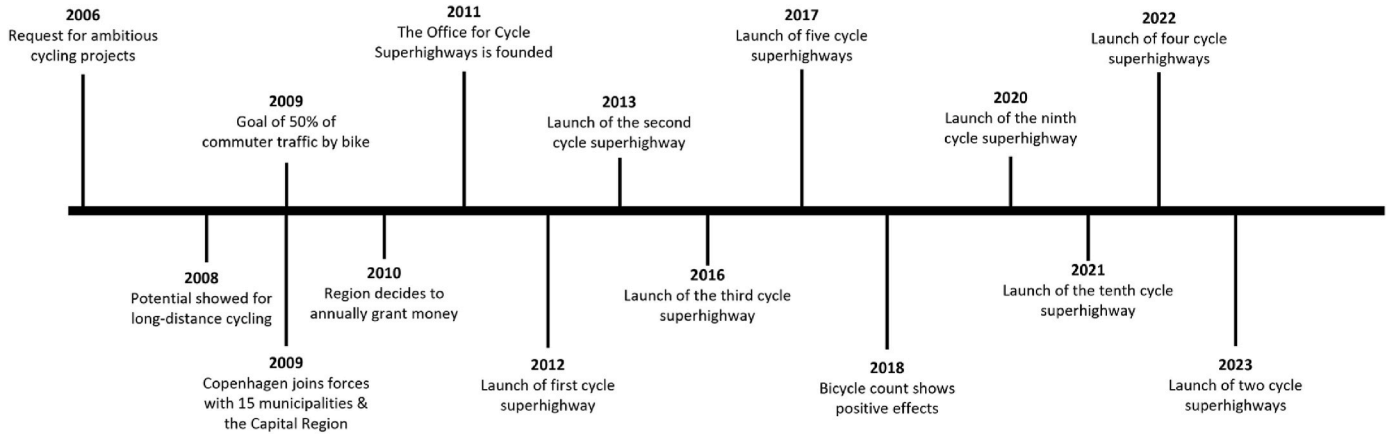

Fig. 7. Timeline cycle superhighways Copenhagen.

4.2.1. Combining sticks and carrots

Sticks and carrots entails combining measures that are experienced as positive and negative. By including measures that provide benefits, the acceptability of restrictive measures increases (Odeck and Bråthen, 2002; van Wee, 2009). Table 1 provides an overview of this success factor in the cases.

The conscious decision to add a positive aspect to a measure that is experienced negatively, as described by Banister (2003), was not visible in the interviews in the studied cases. However, an argument can be made for the presence of this success factor. One of the main reasons for implementing the measures in each city was to reduce the number of cars and give space back to the city's residents. Removing space for private cars is then the stick, and giving that space back, either for car sharing or as living space, the carrot. This is shown in Barcelona, Bremen and Milan. When residents in Barcelona did not notice improvements as a benefit after cars were removed in the first Superblock, they protested. When they see new green areas are added, and children can play outside, they do not mind as much.

Another dimension of the sticks and carrots success factor is the question of who handles the sticks and carrots. Increasing societal

Fig. 8. Impression of piazze aperte milan (under creative commons license).

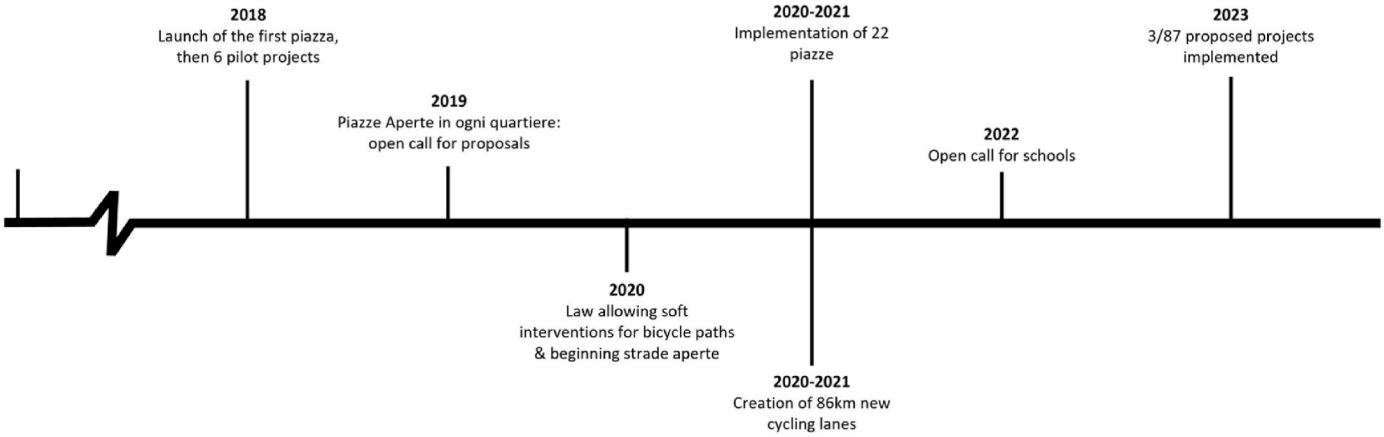

Fig. 9. Timeline piazze & strade aperte milan.

Table 1
The success factor 'Combining Sticks (S) and Carrots (C)' in cases.

Barcelona	Bremen	Copenhagen	Milan
Reducing car parking (S) and creating new space (C) goes together. Residents must see the benefits.	Car sharing (C) reduces the overhead of car ownership (S).	The advantages of cycling (C) are deliberately not coupled to other measures (S).	Showing residents the advantages (C) of reducing car space (S) takes time.

acceptance implies that the measure is directed at the general public. However, the Copenhagen case shows that policy can also be directed at a different level of government. Working on a positive product may increase acceptance from residents. However, the Office mainly needs to convince Mayors to participate in the Cycle Superhighways, who are then free to add measures that restrict car use. To convince the Mayors to participate, they decided not to add a restriction to car usage. This makes it politically easier for the Mayors to build Cycle Superhighways.

Table 2
The success factor 'Showing Openness and Flexibility in Negotiations' in cases.

Barcelona	Bremen	Copenhagen	Milan
Changes to the Superblock design by residents.	Residents and politicians can change the design and location of stations.	The standards are guidelines and municipalities can implement the Cycle Superhighways as they choose.	Residents send applications for new transformations and participate in the design.

4.2.2. *Showing openness and flexibility in negotiations*

Openness and flexibility in negotiations entails allowing negotiations, exemptions and adjustments to increase the likelihood of implementation. Table 2 provides an overview of this success factor in the cases.

In all four cases, the success factor of showing openness and flexibility is crucial in the implementation and gaining acceptance. In Barcelona, Bremen and Milan, residents can give their opinion on the implementation of the measure. In Copenhagen, the responsible department does not collaborate directly with citizens but with municipalities. Allowing municipalities freedom in how they implement the measure increases the likelihood of participation, but may not provide all benefits. In the literature, the risk of a watered-down scheme has been shown (Banister, 2004a), though as Langmyhr and Sager (1997) note, a crude scheme is better than no scheme, and adjustments can always be made after implementation (Sørensen et al., 2014). This shows nearly the exact mentality of the Office for Cycle Superhighways in Copenhagen, where employees actively pressure municipalities to improve the cycle paths after implementation.

Another aspect of flexibility is the question of when policymakers are open to changes and when they stop being open. Once a measure has been implemented definitively, it can become more expensive and difficult to make changes. This can be seen in Bremen, where politicians, residents and governmental departments are included in the design process of the stations. Once the stations are placed, they are rarely

changed or updated. In Milan, residents propose transformations that are further designed in a participatory process. As the measures are first implemented tactically, changes can be made later. Milan first ran several pilot projects that were designed top-down before allowing residents to make proposals for future projects. In Barcelona, the Superblocks are also designed with a participatory process after the initial three-week pilot. The Superblocks are updated as policymakers discover what does and does not work. This was especially the case for the initial Superblocks. Building tactically extends the period in which changes can be made before changes to the permanent intervention become expensive and difficult. The routes of the Cycle Superhighways in Copenhagen are carefully designed with the municipalities before being built. Though the route through a municipality is less important, they do need to align at the municipal borders. Making such changes would require large investments in both time and money. However, flexibility in the quality of implementation is purposefully kept open. This allows municipalities to upgrade the routes later. In fact, the office of Cycle Superhighways regularly reminds municipalities that they are still open to upgrade the routes.

4.2.3. Trials to create legitimacy

Most cities implemented trials before rolling out a measure. Table 3 provides an overview of this success factor in the cases.

Sørensen et al. (2014) show that pilots can help gain experience with the measure, and by communicating its effectiveness, the public is more likely to accept it (Odeck and Bråthen, 2002). Trials can also help break political deadlocks and lock-ins in the existing regimes (Sørensen et al., 2014). This description matches that of the first Superblock in Barcelona very well. The political deadlock showed little chance of changing by itself. Though the sitting Mayor and the Mayor before had agreed to implement the Superblock, they were not planning on actually doing so. The demonstration of the Superblock by the architecture universities helped to show them, and the public, the benefits and was the beginning of a shift on a higher level. The experience they gained after implementing the Superblock was used to design the participatory process for the following Superblocks.

In Milan, pilots were a clear part of the implementation strategy. They used the pilots to gain experience and design tools for the following squares. The pilots showed the effectiveness of the project and helped to increase acceptability by the public so the future projects began from bottom-up proposals. Each intervention in Barcelona and Milan can be seen as a trial. They first implement each intervention tactically by making temporary changes. Changes can then be made before it is implemented permanently later. Due to legal issues, Bremen had a less clear distinction between pilots and non-pilots. However, they did use their experience to keep improving later projects. In Copenhagen, none of the interviewees regarded the first Cycle Superhighway as a pilot. Immediately, they built the full route and continued building others. However, they did learn from their experiences and designed following cycle highways.

Finally, the role that different stakeholders have in pilots is analysed. Policymakers designed the Milan pilots to gain experience with the implementation of the measure. Knowledge institutes initiated the Barcelona pilot. This shows that though policymakers from the municipality do need to be involved, they do not need to begin the pilot. The pilots were designed relatively top-down and involved the residents much less than when the measure was implemented later, not as a pilot. Their experience from the pilot was used to design a method for future implementation with larger stakeholder involvement.

4.2.4. Applying communications strategically

Strategic communication can influence the public's perceptions about the effects of a measure. Table 4 provides an overview of this success factor in the cases.

Some form of strategic communication is visible in all cases. However, they differ in executing stakeholder, targets and goals.

The Barcelona Municipality hired an independent communication team for the first Superblock to be on the streets and talk to residents and local businesses. This team was also fully integrated in the design and implementation process in the following Superblocks. Communication is used to improve public perception of the programme, and decrease resistance. In Copenhagen, communication was one of the five main pillars of the Office. The goal of which is to improve policymaker's and public perception of the project to ensure routes are built and upgraded. In Bremen, external communication teams are hired for various campaigns to increase the number of car-sharing users. Finally, the main goal of communication in Milan is to increase participation of residents in designing proposals for transformations. Policymakers put significant effort into explaining the measures and the reasons for implementation.

Cornish et al. (2011) show that a strategic communication strategy can increase understanding if the objectives are stated and reduce the risks of poor results. The strategy should recognise the diversity of the target audience (Grenna et al., 2003) and executed by hired external communication teams (Sørensen et al., 2014).

4.2.5. Timing and windows of opportunity

The timing of the introduction of a policy can be crucial for its success. Sometimes, a policy can only be implemented if all the circumstances are right. The problem, policy and political streams need to join for the window to open. A policy entrepreneur can use the policy window to implement their solution. This success factor is shown to be of importance, and the moment that the window opens is identified in three of the cases. Table 5 provides an overview of this success factor in the cases.

According to Kingdon and Stano (1984), the problem, policy and political streams need to converge for a window of opportunity to open and a policy to be implemented.

In Barcelona a window of opportunity opened when a new Mayor was elected who favoured the Superblock pilot proposed by the Architecture Universities to solve the problem of high air and noise pollution resulting from cars in the city. The Deputy Mayor acted as an entrepreneur and convinced the Mayor to continue the project while facing resistance. In Milan, the Open Squares project existed for several years but took off when poor liveability became apparent during COVID-19. As the problem intensified, the Municipality could implement many more open squares than before.

The windows of opportunity are less sudden in Copenhagen and Bremen. In Copenhagen, the project was boosted after the congestion charge turned out to be unsuccessful, but the will to reduce cars still existed. In Bremen, residents were sharing cars in a small organisation,

Table 3
The success factor 'Trials to Create Legitimacy' in cases.

Barcelona	Bremen	Copenhagen	Milan
The first superblock was a three-week trial to explore effects.	The stations were only permitted as a trial until new legislation was passed.	The first Cycle Superhighway was built fully immediately without a trial.	The first squares were transformed as pilots to test the technique and methodology.

Table 4
The success factor 'Applying Communications Strategically' in cases.

Barcelona	Bremen	Copenhagen	Milan
Residents are included in the design process and a team involves the community.	Residents receive information about car-sharing and the municipality uses careful wording.	The Superhighways are easily recognisable and the Office communicates effects.	Residents are involved in the design process.

Table: 5
The success factor 'Timing and Windows of Opportunity' in cases.

Barcelona	Bremen	Copenhagen	Milan
Superblocks were implemented when a new Mayor took office.	The first shared cars came after the Municipality was convinced.	The willingness to build the Superhighways grew when the congestion charge ended.	The programme was boosted during COVID-19 as transformations were easier.

and the multiple openings of windows of opportunity allowed different aspects of the programme to succeed.

There seems to be another element to the success factor of timing: the element of controversy. In Barcelona, policymakers were not willing to implement the measure as it was controversial among the public. Aligning the streams required an entrepreneur to use the window of opportunity. In Milan, the project sped up when its controversy was reduced during the pandemic. In Bremen and Copenhagen, the policymakers did not experience their measures as controversial and were immediately willing to implement them.

In the literature, the effect of electoral cycles was also discussed (Hamilton, 2012). Politicians can time the announcement and implementation of measures to the elections to their advantage. This advice was also given in several interviews. If politicians implement a controversial immediately, people have time to adjust to the new situation when the next election starts.

4.2.6. *Organising responsibility and set-up*

New organisations can be established if it is likely that existing ones are not open to new ideas. Table 6 provides an overview of this success factor in the cases.

Low and Astle (2009) found that establishing a new organisation can help overcome fixed practices and create paths that are in line with the new assumptions. All four cases confirm this. In Milan, establishing a new organisation helped to create a common goal. The interviewees from Barcelona and Bremen stated that having a new organisation helped, or would help, to have all employees together and work on the project full-time. Giacchino and Kakabadse (2003) find that the decentralisation of power, responsibilities and resources should be given to local authorities. The new Office in Copenhagen was established to deal with the difficulties arising from such decentralisation. Banister (2004b) finds that decentralisation is one of the conditions for successful transport policy implementation. It provides a greater incentive when local authorities can determine their priorities. However, Copenhagen's experience shows that different local priorities can conflict, making collaboration more difficult.

The main difference between the cases is the moment that their office was established. Before the project could start, a new Office was required in Copenhagen. The collaboration between the municipalities would not have worked otherwise. In Barcelona and Milan, a separate office was established once the project had been running for a while, and they discovered that the implementation would work better if the existing departments and municipal workers did not do it. Bremen, the longest-running project, has not yet established a new office but agrees that it would work more efficiently if it did.

Table 6
The success factor 'Organising responsibility and set-up' in cases.

Barcelona	Bremen	Copenhagen	Milan
A new office was established in a later phase of the project and a dedicated team expedited implementation.	Though policymakers would like a separate department, it has not yet been established.	A new office was set up to coordinate tasks between municipalities.	A new working unit was established later in the programme to aid in planning and increase recognition.

4.3. *Barriers*

The barriers named in Section 3.2 are discussed below in relation to the literature and cases.

4.3.1. *Path dependence and lock-in*

Routines, fixed infrastructure or assumptions can cause a certain route to be followed while better alternatives exist. A lock-in can occur when large-scale investments that only fit the current situation are made. This can be prevented by encouraging participatory decision-making. Table 7 provides an overview of this barrier in the cases.

Low and Astle (2009) distinguish three factors that cause path dependence: institutional, technical and discursive factors. Path dependence in Bremen shows a clear example of how discursive factors influence the outcome. Assumptions within the organisations of developers shape their practices and are self-reinforcing. Building parking spaces for new residents implicitly encourages residents to buy cars and require parking. The same discursive factor is visible for the Municipality and their assumptions about which areas would use car-sharing. In both cases, interacting with other stakeholders, such as potential future customers or residents in certain neighbourhoods, can help them to test their assumptions.

In both Milan and Barcelona, all three factors are visible. Technical factors relate to fixed infrastructure causing car dependence. Car parking is available everywhere and roads designed for cars instead of alternatives strengthen traveller preference for cars. Institutional factors relate to the standard operating procedures and routines in organisations. This factor is strongly visible in the quote by the technician in Barcelona about the routine not being able to change. Discursive factors can be seen in the residents who complain about the inefficient use of public space. The belief that car parking is a good way of using space, but an empty space is not, influences the policy's acceptability.

In Copenhagen, institutional factors result in cyclists not receiving a fair tax discount when compared to car drivers. A discursive factor is that the Transport Minister did not find the Cycle Superhighway prestigious enough.

None of the interviewees stated that they were currently undertaking action to prevent future path dependence and a lock-in. However, possibly without realising, the Municipalities of Barcelona and Milan are minimizing the likelihood of path dependence by supporting participatory decision-making. By using the heterogeneity of society under the conditions of the municipality, future support can be created.

4.3.2. *Policy and institutional barriers*

Conflicts in interests between interested parties can halt the implementation of measures. These can include private and public organisations and departments. Table 8 provides an overview of this barrier in the cases.

Kalaba (2016) indicates that a lack of coordination between departments and different levels of government can result in conflicts of interest. Barcelona's conflicts were a result of the political interests of departments not being in line. It was politically advantageous for the mobility department to not cooperate in the project. The conflict of

Table 7
The barrier 'Path Dependence and Lock-In' in cases.

Barcelona	Bremen	Copenhagen	Milan
Residents and municipality departments are used to designing around cars.	Developers were afraid to reduce parking spaces because they thought residents expected them.	The existing ideas of prestigious projects hinder the Cycle Superhighways.	People assume cars are a good use of space and changing that is difficult.

Table 8
The barrier 'Policy and Institutional Barriers' in cases.

Barcelona	Bremen	Copenhagen	Milan
Political conflicts of interest caused departments to defer from helping the implementation of the Superblocks.	National policymakers were hesitant to allow car-sharing stations on public land.	Mayors from different municipalities have different interests but they are all required to build route.	Other departments within the municipality were not keen on helping.

interest on different levels of government is visible in Copenhagen. The main interests of the municipalities are different from those of the Superblock Office, which are different from those on a national level. Coordinating this proves to be a difficult task. In Bremen, the policymakers discovered something similar. To implement a car-sharing station in Bremen, they needed the national law to change. The policymakers and ministers had different interests, and it took the Bremen municipal workers many years to get the approval they needed. Finally, in Milan, different departments were not willing to collaborate. This changed when the Mayor made car reduction a goal for the entire city.

4.3.3. Legal barriers

Existing legal frameworks can make it difficult to introduce new measures or technologies. Table 9 provides an overview of this barrier in the cases.

Non-supportive legal frameworks can constrain policy implementation and may require the lengthy and burdensome process of changing legislation, which is not always possible. Bremen showed the best example of constraining laws. Building car-sharing stations was legally not allowed, and it took them seven years to change the national legislation and another two for the required law to be passed in Bremen. The policymakers did manage to continue with the programme by labelling all stations a pilot. For the bicycle path programme to begin in Milan, laws also had to be changed. Though it is unclear how long that took, it was quicker than in Bremen. In Copenhagen, the legislation did impact how the measure was implemented. Signage rules did not allow for the orange line they designed on the asphalt. Finally, in Barcelona, laws did not hinder the measure being implemented, but court cases did provide a challenge after implementation.

4.3.4. Resource barriers

Resource barriers exist when policymakers cannot find sufficient financial and organisational backing or have insufficient land or material resources. Table 10 provides an overview of this barrier in the cases.

Resources are needed in the long and short term, and unavailability can cause implementation to be delayed. The difficulty of finding resources and the effect that the lack of financial resources has is most visible in Copenhagen. The Office of Cycle Superhighways and the available funding for the municipalities are uncertain and have a high impact on how the measure is implemented. Without funding, the Municipalities will not build a Cycle Superhighway. In Barcelona and Milan, the Municipalities need funding to make the tactical interventions permanent. For the short term, this raises a barrier to completing the transformation, but also a long-term for maintenance. Besides funding, the Bremen Municipality has difficulty finding space to build the stations they need to meet the dense network they seek.

Table 9
The barrier 'Legal Barriers' in cases.

Barcelona	Bremen	Copenhagen	Milan
Court cases were initiated about removing the interventions after the programme ended.	The national law did not allow public space to be used for car-sharing stations.	The recognisable signage that the Office wanted, was not allowed by the road directorate.	Tactical interventions for bicycle paths were not allowed under the existing laws.

Table 10
The barrier 'Resource Barriers' in cases.

Barcelona	Bremen	Copenhagen	Milan
Tactical interventions are implemented at a low cost, but making them permanent requires more funding.	The municipality has difficulty finding space for the stations.	Municipalities often cannot participate or adhere to the standards due to financial priorities.	Tactical interventions are implemented at a low cost, but making them permanent requires more funding.

4.3.5. Social and cultural barriers

When the level of acceptance is low among those concerned, it can result in public and political resistance. Such resistance can form a barrier to implementing policy. Table 11 provides an overview of this barrier in the cases.

In Barcelona and Milan, policymakers discovered that by showing residents the advantages, such as the increased amount of green public space benefiting them and the children, public acceptance increases. In Bremen, policymakers noticed that the financial benefits were insufficient to convince potential users. The reduced effort of not having to worry about a private car works better. In Copenhagen, the benefits of the Cycle Superhighways are less noticeable for non-cyclists. This impacts the acceptability.

In Bremen and Milan, the project has been tied to a political party, and its future is uncertain. In Barcelona, it has already ended due to a different political party winning the elections. In Copenhagen, the existence of the Office depends less on politics as it has not been tied to a specific party. The fact that it impacts the space and accessibility of cars may also make it less controversial. However, the cooperation of the municipalities is dependent on the willingness of the Mayor in power at that moment. This does significantly affect the measure's implementation.

4.4. Missing success factors

In addition to the previously determined success factors, two other success factors were discovered during the case studies. The framework derived from the literature did not cover these, but they did affect the implementation of the measures. The two missing success factors are discussed in this section, together with the lessons learned from the Municipalities' experiences.

4.4.1. The inarguability of schools

Interviewees from the cities of Barcelona, Milan and Bremen indicated that schools and children travelling to school provide an opportunity to implement car-reducing measures. Interviewees from these cities have discovered that when children's safety and health are at

Table 11
The barrier 'Social and Cultural Barriers' in cases.

Barcelona	Bremen	Copenhagen	Milan
Public opinion about the Mayor was not positive and the project was connected to her party.	Residents like owning a car and convincing them to use shared cars is difficult.	Public acceptance of cycling is not always positive, causing municipalities to not invest.	Owning a car is part of the culture, resulting in resistance when parking spaces are removed.

Table 12
The success factor 'The Inarguability of Schools' in cases.

Barcelona	Bremen	Copenhagen	Milan
Acceptance of the Superblocks grew when parents and schools organised themselves.	Stations received more public acceptance by improving the safety of children on their way to school.		School communities were most engaged. The final part of the project focuses on transforming school areas.

stake, even the most pro-car associations cannot argue with the measure. Table 12 provides an overview of this barrier in the cases.

Improving the safety and health of children increases the acceptance of a car-reducing measure. This works in two ways. If possible, policymakers should begin implementing the measure around schools. Especially in pre-tertiary education, external school traffic can be significant (Nalmpantis, 2021). Politicians and the public cannot argue with measures that improve this area, and school communities are active and willing to help. The second way is by communicating the benefits a measure has on children. If residents know about the effect it has, they are more likely to accept it.

4.4.2. *The undeniability of hard evidence*

This factor is related to the factor of strategic communication but emphasises the effect of hard evidence. Cornish et al. (2011) find that strategic communication helps to integrate perceptions while planning a measure and promoting particular behaviour. However, from the cases, it becomes clear that the communication should not end there. After a measure is implemented, results should be published stating the exact effect it had. Therefore, data must be collected before and after implementation. Table 13 provides an overview of this barrier in the cases.

Data is collected about the effects of measures in each of the cities. Registering the situation before and after the measure is implemented can help increase acceptance and decrease barriers. It also helps to prove claims about its effectiveness and disprove claims by opponents of the measure. Therefore, it is strongly recommended for policymakers to collect data and communicate it to the public. This data can also be used to make calculations and estimations about further effects it has, such as on air quality and health benefits for the population.

4.5. *Dependencies between success factors and barriers*

To increase understanding of how the success factors can be used to overcome the barriers, this section explores the dependencies. Many of the factors from the literature prove to be interdependent in the cases. Appendix C shows our analysis from these dependencies in the cases. Most interdependencies show connections between success factors and barriers, indicating that a success factor can be used to lower or even overcome a barrier. The *path dependency* barrier, for example, can be lowered by *trials* and *showing flexibility*. *Trials* can both help in reducing the likelihood of a lock-in and overcome existing *path dependence*. In Barcelona and Milan, *trials* helped to show the effectiveness of the project, convincing residents and policymakers to cooperate. By beginning with a *trial*, they accepted the measure. As the measures' positive effects were demonstrated, stakeholders changed their mindsets. *Flexibility* can help prevent a lock-in through a participatory and flexible design process. If multiple stakeholders take ownership, a more resilient implementation can prevent being locked into a single point of view.

Table 13
The success factor 'Undeniability of Hard Evidence' in cases.

Barcelona	Bremen	Copenhagen	Milan
Monitoring the area helped to show the positive effect on the environment and that the Superblocks did not disrupt traffic.	Data about the number of private cars replaced by shared cars helped to gain attention and change German law.	Evidence-based facts helped to convince governments to cooperate and finance the project.	Accident data is used to transform the most dangerous intersections and show people feel safer afterwards.

The cases show how *policy and institutional* barriers are interdependent with *organising responsibility*. In all four cities, a new department was set up or an existing department was mandated to facilitate inter-departmental and -governmental cooperation. The barrier also shows to be interdependent with the success factor of *strategic communication*. The Office of Cycle Superhighways in Copenhagen is careful about how they present the project to the municipalities, emphasizing their importance in the project.

The *social and cultural* barrier is linked to *timing and windows of opportunity*. Demand from society can open a policy window or keep it open. When the Mayor wanted to end the Superblock trial in Barcelona, demand from residents helped to restart the project and keep it when faced with resistance. Also, external factors like COVID-19 caused public opinion to change in Barcelona and Milan. Where the projects had little support at the beginning, support grew as people became more aware of the effect that cars had on liveability in the city. The second success factor related to the *social and cultural* barrier is *strategic communication*. Carefully *communicating* to the public about a measure is a means to improve acceptance. In Bremen, this is done through various channels such as advertisements and children's books. In Copenhagen, the Cycle Superhighways are labelled 'super' to make them sound positive and imply a certain quality.

The *resource* barrier has the strongest interdependency with *showing flexibility*, followed by *trials*. As shown in Fig. 10 in Appendix C, being *flexible* can help in dealing with a *lack of resources*, and *trials* are a low-cost way to gain experience with a measure. The resource barrier is also linked to the success factor of *timing and windows of opportunity*. In Barcelona, external factors like COVID-19 increased the available funding for the project. As awareness of the importance of health and liveable outdoor space increased, more funding was made available.

The *legal* barrier has a strong interdependency with the success factor of *trials*. To overcome the *legal* framework not allowing the municipality of Bremen to build car-sharing stations on public land, they labelled all stations as pilots until the law changed. As pilots, the car-sharing stations were allowed to be placed, though the public space was still not officially reserved for the parking of shared cars.

5. Discussion

This Section discusses lessons from the success factors and barriers, the contributions of the research and recommendations for future research.

Case studies in the literature on sustainable mobility policies for increased liveability and healthier environments focus on specific themes addressed in this paper. Examples of case studies relevant to this paper use specific theoretical and/or practical models (Alberti and Radicchi (2022), analyse a concept's potential for expansion (Eggimann, 2022) or uncover case-specific results (Brenner et al., 2024).

5.1. *Lessons*

Western European cities can benefit from the results and contextualisation of this analysis. The lessons that follow the comparison of success factors and barriers between literature and case studies are used to understand the success factors and barriers better. Within each lesson, the relevant success factors and barriers are discussed, together with the contextualisation and next steps for policymakers. These lessons are meant to be used to continuously evaluate and adapt policies and the implementation process and they should be used together and not independently.

5.1.1. Lesson 1: continuously explore new possibilities

Cities should continuously explore new possibilities for policy implementation to achieve their car-reducing goals. Cities across the world are implementing innovative policies. They can use new technologies, such as the system used for shared cars in Bremen and new techniques, such as tactical urbanism in Milan. The potential of new ideas can be explored by keeping in contact with other cities about policies and their effectiveness. It will highly depend on the context if a measure that is effective in one city will work in another. Policymakers should compare the context-dependent factors that are relevant to the success of a policy.

5.1.2. Lesson 2: Be aware of the context and stakeholders' needs

Awareness of the context can help explore and utilize new possibilities and quick implementation during windows of opportunity. Each situation is different and policymaking must be adapted in accordance. In Milan, legislation did not allow for tactically designed bicycle paths. As soon as the legislation changed in Milan to allow such tactical bicycle paths, they were able to use the window of opportunity created by the COVID-19 pandemic.

Awareness of all stakeholders' needs and interests is important when implementing new measures. This includes directly affected stakeholders, such as residents, local businesses, and policymakers. Adjusting and framing a measure so the stakeholders' needs are met will increase the likelihood of implementation. Most interviewees noted that this flexibility is key to success. For the Superblocks in Barcelona, governmental employees had weekly meetings with residents to discuss the implementation and make adjustments. In Bremen, the Municipality not only needed to consider the needs of local stakeholders but also the interests of national policymakers. These national policymakers resisted changing legislation that would enable dedicating public space to shared cars. Existing ideas about city design and transportation need to be transformed. If residents have difficulty parking their cars, such as in Bremen, shared car stations can solve that problem by reducing the number of privately owned cars. If residents cannot play outside with their children, transforming the area can help to create more living space, such as in Barcelona.

5.1.3. Lesson 3: create and identify windows of opportunity

To successfully implement or pilot a measure, policymakers need more than a policy (as defined in lesson 1), a problem and political willingness (as defined in lesson 2). They also need an opportunity to implement the measure when these three streams meet. Policy entrepreneurs, such as the universities that initiated the pilot in Barcelona, and politicians, such as the Deputy Mayor who turned the pilot into a permanent transformation, can identify and create windows of opportunity. Policymakers also have the power to implement the possibilities they explored, as seen in Milan. When a window opens, they must be prepared to implement their designed policies. Depending on the type of measure, the windows may open briefly or for a longer time. For controversial measures such as those in Barcelona and Milan, policymakers must act quickly to use the window to their advantage and implement the measure. Being prepared for such situations and knowing the requirements will help to utilize these windows. For less controversial measures, such as those in Bremen and Copenhagen, the windows open and close less abruptly, giving policymakers time to improve the design.

5.1.4. Lesson 4: test new measures

The final lesson for Western European cities is to test newly designed measures before implementing them permanently. Piloting measures allows policymakers and stakeholders to experience the effects of implementation and allows for radical experimentation, as shown in the superblocks in Barcelona. Policymakers can experiment with such measures when stakeholders' willingness is low to break path dependence and demonstrate the advantages of alternatives to an existing system. Communicating to opponents that the transformations in Milan can be changed if needed allows for more radical transformations. Policymakers should consider testing a measure before full implementation. Not all measures are suitable for deployment on a small scale. The main challenge for the first cycle superhighway in Copenhagen was setting up the required collaboration. Once achieved, they decided to implement it fully.

5.2. Contribution of the research

This paper analyses how and why specific car-reducing policies have been implemented in four different Western European cities. A framework is proposed on the barriers and success factors that they have encountered during the implementation process, with two newly discovered success factors. This results in lessons for policymakers in other cities regarding the implementation process. The case study approach explores events in everyday contexts and explains why one implementation of a car-reducing strategy may be chosen over another. This paper addresses the knowledge gap and lack of research into real-world qualitative policy analysis. Much of the literature does not engage with actual cases, thereby increasing the distance between theory and reality. However, a limitation inherent to case studies, is the uncertainty around generalisability. In particular for this paper, not all findings may be expanded to cities outside of Europe, cities with different population sizes or cities with different socio-economic structures. The success factors and barriers are likely to be present, but their dependencies and importance may differ. This paper addresses the influence of governance, context, power, resources and legitimacy on policy implementation. More specifically, the governance questions of how and why policies are chosen and framed and how they evolve are addressed. Solving these gaps can aid the transition toward sustainable mobility.

5.3. Recommendations for future research

This analysis of this thesis is directed at Western European cities with a population range of 450,000–1,650,000. This increases the possibility of comparing and drawing lessons for cities of that size. Building on this paper, researchers can expand their knowledge in the field of success factors and barriers.

The first suggestion for future research is to statistically validate the presence of the factors and barriers in more cities. A more quantitative analysis could show the presence of these success factors and barriers in more cities within this range. This could also confirm if stakeholders in other cities recognise the two new success factors. Validation could be performed in a structured interview, such as a questionnaire.

The second suggestion for future research is to perform similar research to this thesis outside of (Western) Europe to determine if policymakers from other parts of the world face the same success factors and barriers or if their environment adds a different complexity.

The third suggestion for future research is to perform a similar analysis to this thesis for cities with a different population range or different selection criteria. It is possible that other types of cities have different complexities, and it is unclear what the implications of this research are for smaller or larger cities. The literature used to determine the success factors and barriers is not limited to the criteria used in this thesis and is likely also relevant to other cities. However, additional factors and barriers may appear, together with different dependencies.

The final suggestion for future research is to compare a measure's perception between policymakers and other stakeholders. In this research, policymakers were mostly interviewed. This may give a one-sided perspective of the measure, and discovering the difference in how policymakers view it compared to the people directly affected by it will add different perspectives. An analysis of the differences, perhaps also over time, may give more context and validity to the statements made by the policymakers.

6. Conclusion

The case studies showed that the barriers can cause significant delays in policy implementation or can even halt implementation completely. The success factors can assist policymakers in addressing the barriers. For the implementation of policies, policymakers can learn from such experiences when designing and developing new policies. The challenges that are faced indicate the need for transformational adaptation. Four lessons are identified for policymakers to address these challenges: continuously explore new possibilities, be aware of the context and stakeholders' needs, create and identify windows of opportunity, and test new measures. Applying the four lessons learned for policymakers is essential to its success.

In the analysed cases we have seen that policymakers face different challenges in the implementation of car-reducing measures. We have learned that there are strategies to address these challenges. Policymakers should not be hesitant in radically changing the existing systems to achieve ambitious, but highly necessary, car-reducing goals. Luckily, these policymakers are not alone. Considering only Europe, there are many local governments with similar goals that have experience with implementing measures and are also looking to gain new insights. Therefore, policymakers from different cities should reach out to each other, identify their differences and similarities, and work together to address these challenges. There are many different measures that cities can implement to achieve their car-reducing goals. We are interested in the experiences that cities have with our lessons and newly determined success factors. This is an interesting future research path and the proposed framework may provide a basis for future case studies in Western Europe and abroad.

Policymakers should not forget that they are not alone in the process of designing and implementing policies. Understanding and involving local stakeholders helps to create successful policies that meet their demands and create a broader acceptance. Successful policies should therefore not simply be copied between cities. Many context-dependent factors significantly impact the implementation of a policy. Experimenting with the measures and experiencing their effects can help to make adjustments before full-scale introduction.

We hope this paper leaves you inspired to collaborate with others and improve the liveability of cities throughout Europe and abroad. Transformation is a difficult but rewarding challenge. If we work together, learn from each other and create opportunities in which we dare to make radical changes, we believe we can overcome all barriers and make cities an even better place to live.

CRediT authorship contribution statement

Johannes C.T. van der Lee: Writing – review & editing, Writing – original draft, Resources, Project administration, Methodology, Formal analysis, Data curation, Conceptualization. **Wijnand W. Veeneman:** Writing – review & editing, Resources, Methodology, Conceptualization.

Funding

This work was supported by This paper was performed in the context of the NWO-funded XCARCITY project at TNO. The project focuses on the challenge of reducing cars in city centres and the related dilemmas. XCARCITY.

Declaration of interest

This paper was performed in the context of the NWO-funded XCARCITY project at TNO. The project focuses on the challenge of reducing cars in city centres and the related dilemmas. XCARCITY aims to make urban regions sustainably accessible whilst increasing liveability with seven work packages and thirty-two partners. Among these partners are TNO and TU Delft (NWO, 2023). During six years and beginning in 2023, the project assists municipalities, developers, civil society organisations and transport operators in pursuing optimal mobility solutions for a liveable city (TU Delft, 2022). This research is embedded in the project, seeking to discover the success factors and barriers in implementing car reduction measures.

Acknowledgements

The authors are grateful for the support of various TNO colleagues, including Leonard Oirbans and Maaike Snelder, and the second supervisor Jan Anne Annema for his support.

Appendix A. Interviewee coding

Table 13
Interviewee coding

Interviewee ID	Date	City	Organisation
Ba1	18-12-23	Barcelona	City Council: Urban strategy
Ba2	21-12-23	Barcelona	City Council: Urban strategy
Ba3	10-01-23	Barcelona	City Council: Urban strategy
Br1	19-12-23	Bremen	Municipality: Sustainable Mobility
Br2	22-01-24	Bremen	Municipality: Mobility and City Development
Br3	26-01-24	Bremen	Municipality: Ministry of Construction, Urban Development and Transportation
Co1	19-12-23	Copenhagen	Office of Cycle Superhighways
Co2	8-01-24	Copenhagen	Design Company
Co3	31-01-24	Copenhagen	Office of Cycle Superhighways
Mi1	14-12-23	Milan	Municipality: Mobility and Environment
Mi2	14-12-23	Milan	Municipality: Mobility and Environment
Mi3	24-01-24	Milan	Municipality: Housing & Neighbourhood

Appendix B. Interview protocol

Thesis Johannes van der Lee– Success factors and barriers from car reduction

Thank you for agreeing to this interview for my thesis at the TU Delft regarding success factors and barriers in the implementation of car reducing measures. Before we begin, is it okay if I record the meeting?

In this research, I will be performing case studies on 4 different European cities and interviewing different relevant stakeholders in the policy implementation in each city. I will asking several questions regarding your experiences in the process.

1. How does your city look at the current number of cars in the city?
    a. Which measures?
    b. (b) Why have these measures been selected?
2. Online I found that your city has implemented this car-reducing measure:\
   Copenhagen: Infrastructure for active mobility
   Bremen: Shared cars
   Milan: Transforming squares & building infrastructure for active mobility
   Barcelona: Limited traffic zone in Superblock
   a Is that correct, have these measures been taken? Have I missed any?
   b Why have these other measures been selected?
3. Please tell me about these moments and processes of implementation of these measures.
   a Where did the measures originate?
   b Take me through the implementation process, what happened?
   c What are key moments in the implementation?
   d What happened during these key moments?
   e Which stakeholders were involved in each key moment and what was their position?
   f What caused the outcome in each key moment?
   g What were the problems during each key moment?
   h How did you overcome these problems?
4. How long did it take to implement the measures?
   a When did it begin and from when were you involved?
   b What happened when you were involved, what were issues?
5. In the literature I have found several other success factors that can be present in the implementation of such measures. Do you find that they also existed in the implementation of your measures?
   a **Sticks and carrots** entails combining measures that are experienced as positive and negative. By including measures that benefit the public, the acceptability of restrictive measures increases.
      i Did you use a strategy of sticks and carrots?
      ii What would you define as the carrot?
      iii How was the carrot defined?
         1 Which stakeholders were involved?
         2 What was the timeline in communicating and implementing the sticks and carrots?
         3 How was the funding organised for the sticks and carrots?
      iv Did it work? Did the people who receive the sticks also receive the carrot?
         1 Were they satisfied with the carrot?
   b **Showing openness and flexibility in negotiations** entails allowing negotiations, exemptions and adjustments to increase the likelihood of implementation.
      i Are there parts of the measures that you would have liked to be different?
      ii How did these parts end up in the final implemented measures?
         1 Which stakeholders were involved?
         2 What was the timeline? When were the stakeholders involved and when were these decisions made?
      iii Was there a negotiation? How did that go?
         1 Which stakeholders were involved?
         2 When was that negotiation held?
         3 What did the stakeholders think of the outcome?
   c Trials to create legitimacy and acceptance includes both demonstrations and trials to create experience with the policy and increase acceptance.
      i Was the measure implemented at once or did it happen in phases or at a smaller scale first?
         1 Why/why not?
         2 Who was involved in that decision?
         3 When was that decision made?
      ii What was different about the first implementation when compared to the final version?
         1 What was the timeline?
         2 How was the first version received?
         3 By who/which stakeholders?
      iii What caused the measure to be implemented further?
         1 How was it received then?
         2 Do you think the gradual implementation had an effect when compared to an immediate full implementation?

- d **Applying communications strategically** to promote particular behaviour and integrate the perceptions of relevant parties. This can be done through a consultation process.
  - i When were the other stakeholders involved in the process of implementation?
    - 1 How were they informed/involved?
    - 2 Why were they involved at that time?
    - 3 What were they told?
    - 4 Why were they told that?
    - 5 What were their responses about the measure and the timing?
  - ii When was the public informed of the measure?
    - 1 How were they informed/involved?
    - 2 Why were they involved at that time?
    - 3 What were they told?
    - 4 Why were they told that?
    - 5 What was their response?
- e **Timing and windows of opportunity** can be crucial in the success of a policy. Sometimes a policy can only be implemented if all the circumstances are right.
  - i Was the measure proposed earlier?
    - 1 What was the response?
    - 2 What was different about the situation then, causing it not to be implemented?
  - ii Was the measure implemented immediately or did something else need to happen before?
    - 1 What happened and why did that make the difference?
  - iii How were the politics regarding the issue and the solution? Did politicians immediately recognise the problem and the solution?
    - 1 What changed in order to implement the measure?
    - 2 Who was involved in that change?
  - iv How long before the measure was implemented, was it known to the stakeholders?
    - 1 Why was it not implemented earlier?
- f **Organising responsibility and set-up** is done by establishing new organisations if it is expected that existing organisations may repel new ideas. A new working unit can shift responsibility and ensure implementation.
  - i When it was decided to implement the measure, who was responsible?
    - 1 Were the tasks divided?
    - 2 Why were they responsible?
    - 3 How was that decided?
    - 4 Did all involved stakeholders agree?
  - ii Were the responsible stakeholders capable of handling all tasks surrounding the measure?
    - 1 Did they manage to complete their tasks?
  - iii Were the traditional/original organisations/divisions kept or were organisational changes made?
    - 1 Why was that?

6. In the literature I have found several other barriers that can be present in the implementation of such measures. Do you find that they also existed in the implementation of your measures?
   - a **Path dependencies** where routines, fixed infrastructure or assumptions can cause a certain route to be followed while better alternatives exist.
   - b **Policy & institutional barriers** where conflicts in interests between interested parties can halt the implementation of measures.
   - c **Legal barriers** where existing legal frameworks can make it difficult to introduce new measures or technologies. Also, who gets to manage the budget.
   - d **Resource barriers** exist when policymakers cannot find sufficient financial and organisational backing, or have insufficient land or material resources.
   - e **Social and cultural barriers** appear when the level of acceptance is low among those concerned, resulting in public and political resistance.
7. Besides the discussed measures that were successfully implemented, do you know of any measures that were proposed but not successfully implemented?
   - a Can you tell me more about how the process went?
   - b What do you think caused the non-fulfilment?
   - c Did the barriers that I found in literature also exist?
     - i **Path dependencies** where routines, fixed infrastructure or assumptions can cause a certain route to be followed while better alternatives exist.
     - ii **Policy & institutional barriers** where conflicts in interests between interested parties can halt the implementation of measures.
     - iii **Legal barriers** where existing legal frameworks can make it difficult to introduce new measures or technologies. Also, who gets to manage the budget.
     - iv **Resource barriers** exist when policymakers cannot find sufficient financial and organisational backing, or have insufficient land or material resources.
     - v **Social and cultural barriers** appear when the level of acceptance is low among those concerned, resulting in public and political resistance.
8. Who were involved in the implementation process?
   - a Who else should I speak to about it?
9. We have reached the end of my questions. Are there any questions I missed or is there anything else I should know, perhaps regarding the implementation process?

Thank you very much for your participation. I will send you a summary of our conversation and you can send me a message if you would like to make any changes. Can I contact you later if I discover that I missed anything important? Also, feel free to reach out if you would like to add anything.

Appendix C. Dependencies between success factors and barriers

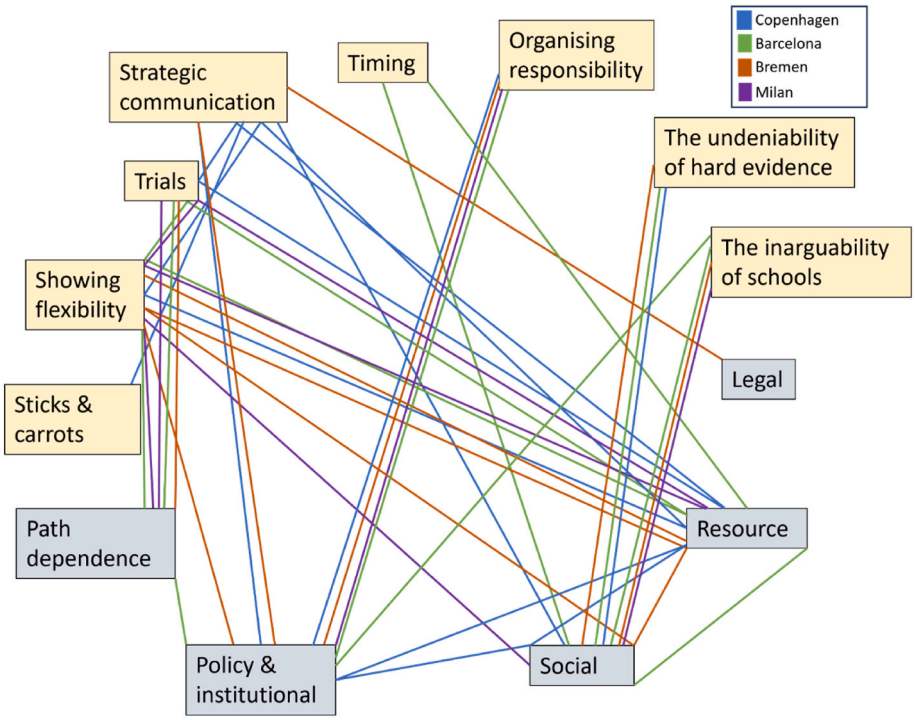

Fig. 10. Dependencies between success factors and barriers.

Data availability

Data will be made available on request.

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