Transportation Research Interdisciplinary Perspectives 7 (2020) 100209

Contents lists available at ScienceDirect

Transportation Research Interdisciplinary Perspectives

journal homepage: https://www.journals.elsevier.com/transportation-research-interdisciplinary-perspectives

The challenge of the bicycle street: Applying collaborative governance processes while protecting user centered innovations

Matthew Bruno *

Department of Industrial Engineering & Innovation Sciences, Eindhoven University of Technology, Eindhoven, the Netherlands
Copernicus Institute of Sustainable Development, Utrecht University, Utrecht, the Netherlands

ARTICLE INFO

Article history:
Received 23 December 2019
Received in revised form 17 July 2020
Accepted 18 August 2020
Available online 6 September 2020

Keywords:
Bicycle streets
Collaborative governance
Strategic policy niche management
Transport policy

ABSTRACT

The innovation of the bicycle street allows missing links in cycling networks to be developed in places where financial or spatial constraints present challenges to implementing separated cycling facilities. Two separate cases in the Netherlands demonstrate that when the intent is to use the innovation to resolve spatial constraints, the goal of reaching consensus between different stakeholders involved with a collaborative governance process can lead to a result in which the user practices necessary to make the innovation a success are not sufficiently protected. These cases show how collaborative governance processes in transportation planning can lead to innovations being implemented in ways that fail to support the group that they are intended to benefit. This argument is supported by drawing on two different bodies of literature: 1) collaborative governance literature that describes the movement to increase the legitimacy of government supported projects through substantial stakeholder involvement; and 2) strategic niche management literature that describes the role that established user practices play in the upscaling potential of innovations. These literatures are connected through the evaluation technique of Strategic Policy Niche Management (SPNM), which has been used to apply strategic niche management principles to innovations in transportation policy. The article uses the concept of SPNM to illustrate the need for understanding the connection between citizens in collaborative governance and users in innovation development. This relationship is illustrated by examining the history of a transportation innovation, the bicycle street, with a particular focus on how its development in Germany and Belgium as a means to provide bicycle infrastructure at low cost differs from its introduction in the Netherlands, where it has been used as a compromise solution between different user groups. The history of the bicycle street and its uses in different contexts is followed by a detailed case study on the contested implementation of a bicycle street in Eindhoven, the Netherlands. This specific case reveals what can happen when an innovative project is undertaken with a focus on consensus among potentially impacted stakeholders and does not give increased weight to the needs of the users of the innovation. The innovation may develop sufficient support to be implemented but may not be sufficiently attuned to user practices to meet the needs of its intended user group, creating an obstacle to future upscaling. The article concludes with a discussion of how adopting specific regulations for bicycle streets could resolve this issue, preventing bicycle streets from being implemented in places where other options would better serve cyclists.

1. Introduction

This article examines the effect of local collaborative government processes on the implementation of transportation innovations. It does this through a focus on a particular innovation designed to support the growth of cycling as part of a sustainable transportation system: the bicycle street. This simple transportation innovation, in which cyclists have priority over cars on mixed traffic streets, has a stronger local component than many other types of transportation innovations, as cycling is largely governed at the local and regional level (de la Albert and Veraart, 1999; Geels, 2012).

When considering the implementation of a particular innovation, collaborative governance, with its focus on stakeholder engagement (Ansell and Gash, 2008), provides a means to bring both the users and non-users of an innovation into the governance process. Scholars in Science and Technology Studies (STS) argue this inclusion is of fundamental importance because of the key role that users play in shaping technology (Oudshoorn and Pinch, 2003). This is particularly relevant for innovations related to cycling, as actual users and users as mediated through advocacy organizations have shaped local and regional cycling cultures (Oldenziel et al., 2016) and where the participation from people who cycle is needed to counter the projected users imagined by transportation engineers that often undervalue

* Department of Industrial Engineering & Innovation Sciences, Eindhoven University of Technology, Eindhoven, the Netherlands.
E-mail address: m.j.bruno@tue.nl.

http://dx.doi.org/10.1016/j.trip.2020.100209
2590-1982/© 2020 The Author. Published by Elsevier Ltd. This is an open access article under the CC BY license (http://creativecommons.org/licenses/by/4.0/).

the needs of people riding bicycles (Oldenziel and Albert de la Bruhèze, 2011).

Cycling innovations are often implemented to promote the broader social goal of moving towards a sustainable transportation system (Krizek et al., 2009; Ogilvie et al., 2011; Song et al., 2017), and therefore the general theoretical framework of sustainability transitions needs to be considered when examining the most effective ways to develop innovative cycling infrastructure. Specifically, the literature on strategic niche management addresses the challenges of advancing an innovation as part of a sustainability transition (Kemp et al., 1998; Schot and Geels, 2008). Strategic niche management literature describes how an innovation can fail when it requires too large of a deviation from established user practices (Smith and Raven, 2012). This concept has already been applied to transportation policy under the theoretical framework of Strategic policy niche management (Ieromonachou et al., 2004). This article will explore the tensions between employing collaborative governance processes while providing adequate support for changes in user practices.

Collaborative governance literature describes how meaningful citizen participation in decision making can lead to successful policy outcomes (Ansell and Gash, 2008; Thomas and Perry, 2006). Strategic niche management literature argues that innovations that require users to make substantial changes in their current practices have an increased risk of failure (Smith and Raven, 2012). When an innovative project is undertaken with a focus on consensus among potentially impacted stakeholders that does not give increased weight to the needs of the users of the innovation, the innovation may develop sufficient support to be implemented, but may not be sufficiently attuned to user practices to meet the needs of its intended user group, creating an obstacle to future upscaling.

The contribution of this paper is thus twofold. First, the article contributes to the scholarship on strategic niche policy management by examining how it functions within the context of collaborative governance. Drawing on case studies that examine the governance processes that led to the implementation of bicycle streets, this article proposes that collaborative processes that focus on consensus can produce unsuccessful outcomes when they involve an innovation in which user practices need to be protected.

Second, it contributes to the debate on transitions to sustainable transportation by articulating the governance issues surrounding the implementation of bicycle streets, an innovative approach to completing cycling networks in order to increase cycling rates. Specifically, the shared space concept of a bicycle street allows it to function as a compromise acceptable to all stakeholders, even though the concessions necessary to implement this compromise have the potential to undermine the functionality of the bicycle street. This article briefly describes the history of the innovation in order to explain the purposes for which it was created and how it is being used in some situations a different purpose: as a tool to resolve disputes over space rather than as a means of providing a low cost bicycle infrastructure in low traffic areas. It also presents an empirical method for evaluating the degree to which people who cycling are asserting their right of way on a bicycle street, the change in cycling practice that defines the innovation.

The sections that follow accomplish this by providing a brief literature review describing the basic principles of two theoretical frameworks: collaborative governance and strategic niche management. The article then presents a brief outline of the bicycle street's historical development and implementation in Germany, Belgium and the Netherlands with a focus on how each country has regulated the bicycle street to ensure that it is used for its intended purpose and implemented it where it can best function. The article then examines the governance processes behind the implementation of one particular bicycle street in Eindhoven, the Netherlands. It describes how a conflict can develop between the goals of collaborative governance and strategic niche management when achieving consensus takes priority over protecting the success of the innovation. Each of these cases show the importance of maintaining the low traffic volumes on bicycle streets and how collaborative governance processes can make achieving that goal challenging. The discussion section describes the role that enforceable guidelines can play in ensuring the successful implementation of user center innovations such as the bicycle street when collaborative governance processes are involved.

2. Methods

In examining the literature on bicycle streets, certain elements have received more attention than others. Several authors have addressed the engineering aspects that lead to the development of successful bicycle streets, such as the necessity of design elements that encourage low speeds (Barter, 2009); the management of elements in shared space that create a perception of risk (Clarke, 2006); and elements that impact the effectiveness of bicycle streets such as street widths, parking, traffic volume and speed limits (Pitera and Mateo, 2014; Godefrooij and Hulshof, 2017; Mansvelder et al., 2013). Other studies have looked at the design elements of specific bicycle streets (Andriesse and Ligtermoet, 2005; Andriesse et al., 2001; CROW, 2016) in order to suggest general design guidelines. The relationship between governance processes and the decision to implement a bicycle street, however, is absent from the literature on bicycle streets.

Because the bicycle street is an innovation that has yet to be used on a wide scale (Delbressine, 2013; Fietsberaad Vlaanderen, 2015; Lehner-Lierz, 2002), it can be considered a niche innovation and the approach to upscaling it would be covered under the principles of strategic niche management (Smith and Raven, 2012). The bicycle street is not a type of infrastructure, however, but a set of policies that shape the use of a street; it therefore fits better under the category of strategic niche policy management (Ieromonachou et al., 2004). While this framework has been applied to aspects of the implementation of congestion pricing (Ieromonachou et al., 2006), it has not been applied to the use collaborative governance in the implementation of an innovative policy. This article aims to address the gap in literature on the influence of collaborative governance processes in strategic niche policy management and more specifically to the role of collaborative governance in the implementation of bicycle streets.

In order to accomplish these goals, the article presents an overview of the development of the bicycle street in Germany, Belgium, and The Netherlands, with a specific focus on its original purpose and the regulations developed across the three countries to protect the practices of cyclists. The article then presents an in-depth case study of a bicycle street in Eindhoven, The Netherlands, that reflects the challenges of both achieving consensus among diverse stakeholders and providing the necessary protections for the users of an innovation.

The historical overview of bicycle streets and the description of the governance processes behind the Eindhoven bicycle street rely primarily on archival material. For the Eindhoven case study, this includes reports from the firms hired to manage the project, detailed meeting notes from participatory groups, and newspaper accounts of the project. These archival materials were supported and put into context through interviews with people knowledgeable with the project and its history: the project leader of the redevelopment, a member of the Eindhoven Cyclists' Union that worked on the Eindhoven bicycle street, and the former national head of the Netherlands bicycle coalition who, during his time as a city alderman was instrumental in implementing the first bicycle street in the Netherlands. Because the majority of the information acquired during these interviews and used in the article is also supported by publicly available sources, most of the interviews are not directly cited in the article (see Appendix A for a list of the primary sources used in the Eindhoven bicycle street case study).

The evaluation of the bicycle street in the case study is based on both published documents and direct observation. The number of cyclists were counted, and their riding behavior observed at three different locations over six one-hour periods. Additionally, a similar process was repeated for one hour at the location of another bicycle street as a control. The case study section provides a brief description of the process as well as a summary and interpretation of the results (see Appendix C for a complete description of the evaluation process, with the results in Table A.1).

3. Theory

3.1. Collaborative governance

Collaborative governance structures are becoming an increasingly common part of developing bicycle infrastructure in the Netherlands. Citizen involvement is often a key element in these collaboration agreements. For example, for the development of a bicycle bridge with a project budget of €11 million, the province of North Holland created what it referred to as a public-private neighborhood cooperation. In addition to holding meetings where residents discussed the project, the private company responsible for the design also walked the project site with local residents and incorporated their feedback into the final design. (Ballast Nedam, 2016).

Arguments for the importance of this type of citizen involvement date back to the 1960's. In 1969, Sherry Arnstein published a model of citizen participation that viewed processes of participation as a means to achieve social reforms and to provide an equitable distribution of government benefits (Arnstein, 1969). Including non-government actors in public sector decision making led to an understanding that more could be achieved through partnering with citizens, community groups and business organizations than could be achieved by a government agency acting independently (Huxham et al., 2000). This understanding led to the development of collaborative governance processes that tried to address the growing interdependence and uncertainty in policy development in an increasingly complex and diverse stakeholder environment (Booher, 2004).

While collaborative governance can take make forms, one group of scholars has defined it as

> the processes and structures of public policy decision making and management that engage people constructively across the boundaries of public agencies, levels of government and/or the public, private and civic spheres in order to carry out a public purpose that could not otherwise be accomplished. (Emerson et al., 2012, p. 2)

While participatory processes in general have been described as having the potential to improve the legitimacy, social justice, and effectiveness of policy (Fung, 2006), and collaborative governance processes in particular have been developed in order to improve the delivery of public goods (Zadek and Radovich, 2006); extend agency resources (Rogers and Weber, 2010); and develop policies that are more responses to the needs of the citizens affected by them (Newman et al., 2004), collaborative governance processes in practice have been subjected to a variety of critiques. This includes the likelihood that future generations and nonhumans will not be adequately represented (O'Neill, 2001) and that power differentials (Davies, 2007; Ghose, 2005) and different ways of knowing (Van Buuren, 2009) can undermine collaborative processes.

This article takes a critical look at collaborative processes in the context of innovation governance, where consensus may be achieved at the cost of the ultimate success of the innovation. In a project that centers on innovation, citizens in their roles as users (and non-users) of the innovation play a crucial role in determining the its form and development trajectory (Hallenbeck, 2012; Kenger and Schot, 2016; Oudshoorn and Pinch, 2003; Schot et al., 2016). The ways in which citizen-user involvement affect the ultimate success or failure of an innovation are absent from collaborative governance literature, and an understanding of them requires understanding the importance of protecting user practices as described in strategic niche management theory.

3.2. The protection of user practices in strategic niche management literature

Transition research examines socio-technical systems, the configuration of elements that allow a specific societal function to be fulfilled (Kenger and Schot, 2016). The social-technical system surrounding the bicycle shares many of the same elements as the automobile (Kenger and Schot, 2016) but these elements are configured quite differently. As a subaltern system (Marletto, 2014), the cultural and symbolic meaning of the bicycle is different from that of the auto, as well as the infrastructure, regulations, policies, and user practices.

Regardless of the particular configuration, strategic niche management literature describes how each of the elements that comprise a socio-technical system have an influence on the adoption of an innovation when it is in the early stages of development (Smith and Raven, 2012). This includes user practices. As stated by Smith and Raven,

> Markets and dominant user practices form a selection environment through stabilized market institutions, supply and demand, price mechanisms, user preferences and routines. Path-breaking innovations have a hard time entering the market, for example, … because they require inconvenient user practices compared to accustomed habits.
>
> [(Smith and Raven, 2012, p. 1026)]

In this context, an innovation will have a greater chance of success if users take action to attempt to adapt the innovations in order to fit with their existing practices and preferences, a response known as fit and conform empowerment (Smith and Raven, 2012). A sustainability transition that focuses on cycling requires attention to processes of adaptation, because the bicycle, with its long history as a means for transportation, touring, and sport, is part of an established system where historically embedded practices are likely to have a strong influence on how users respond to innovations (Shove, 2012).

Strategic niche management literature generally focuses on the innovation trajectory of a particular technology in the context of a sustainability transition (Kemp et al., 1998; Raven et al., 2010; Schot and Geels, 2008). The principle, however, has been extended beyond new technology and applied to issues of transportation policy under the concept of strategic policy niche management. Strategic policy niche management adopts the same principles as strategic niche management, but applies them to policy concepts rather than specific technologies (Ieromonachou et al., 2004). The strategic niche policy management framework has previously been used to analyze the implementation of congestion pricing (Ieromonachou et al., 2006), a policy tool that, like the bicycle street, has been argued to be in support of sustainable transportation goals (Schaller, 2010; Verma et al., 2015).

The brief theoretical overview given above describes collaborative governance and the necessity of protecting the practices required for the use of an innovative technology or policy if the innovation is to succeed. The sections that follow describe the origin and implementation process of bicycle streets in Germany and Belgium, with a specific focus on how users' practices were protected and how these processes differed from the implementation of the first bicycle street in the Netherlands. The article then provides a detailed analysis of the implementation of a specific bicycle street in the Netherlands in which collaborative governance processes undermined the user protections suggested as necessary by strategic policy niche management principles. The case study demonstrates that a project can succeed at incorporating citizen input in ways that move the project towards implementation, but the same decisions that increased the support for the project across stakeholder groups before implementation can challenge the long term success of the project and the innovation itself after implementation. The mixed outcome described in the case study reveals the challenge of achieving consensus while protecting the user practices upon which innovations depend.

4. The origins and purpose of the bicycle street in Germany, Belgium, and the Netherlands

An examination of how and why bicycle streets were introduced in Germany and Belgium helps in clarifying the conditions under which collaborative governance process can undermine the functionality of bicycle streets. Examining the bicycle street in Germany, where it was invented, and Belgium, where it was more recently adopted, shows how these two neighboring countries have both used the bicycle street for more limited purposes than the Netherlands and taken a different approach to its implementation.

The histories of the bicycle street in Germany and Belgium reflect a process of experimenting with a new way to complete bicycle networks where funds for separated infrastructure were not available. This experimentation was followed by the establishment of codified guidelines for a bicycle street, guidelines developed with intention of ensuring bicycle streets served people who cycled by placing restrictions on the autos that used the street.

The first bicycle street in the Netherlands was created for a different purpose. It was not developed due to a lack of funding for bicycle infrastructure but due to a lack of space. The innovation was implemented as a means of managing large amounts of bicycle traffic in places where expanding separated bicycle infrastructure would require politically difficult restrictions on auto parking and auto access. Unlike its neighboring countries, the bicycle street has never been legally codified in the Netherlands.

The following section provides a brief overview of the history of the bicycle street, both in the Netherlands and its neighboring countries, in order to compare and contrast the relationships in each place between the purposes for which the innovation was developed and the ways in which its target user group, cyclists, were supported.

4.1. The German origins of the bicycle street

A bicycle street can be broadly defined as a street that is designed as a bike route but where automobiles and other motorized vehicles are also allowed (Welzen, 2015). The first known implementation of this concept occurred in the German city of Bremen in the early 1980's. Klaus Hinte, the head of the city's transportation planning division, was frustrated by the lack of connectivity in the city's bicycle infrastructure. He was familiar with examples of integrated bike networks in the Dutch cities of Tilburg and The Hague (Lehner-Lierz, 2002). In the late 1970's, both of these cities had implemented bike infrastructure designed to demonstrate the benefits of separating bicycle and auto traffic and had reconfigured intersections to allow cyclists to cross without having to stop (The Hague Office of Public Works, 1978). Hinte, however, had little hope that Bremen would provide the funding necessary to implement this infrastructure intensive policy and looked for a less expensive solution (Lehner-Lierz, 2002).

As an alternative to the more expensive infrastructure that he saw in the Netherlands, Hinte developed the bicycle street concept in the 1980's as a way to provide cyclists more direct routes through Bremen's complicated network of one-way streets. On one-way streets for cars, the entire street became a bike path with bicycles able to travel in both directions. The speed limit for all vehicles was restricted to 10 km/h. In order to accomplish this within the existing framework of German traffic laws, the first bicycle street required 193 signboards, as every intersection, alley and driveway required a re-statement of the rules for both bicycles and motor vehicles (Lehner-Lierz, 2002).

Because of the legal ambiguity of allowing bicycles to travel in two directions on a street that allowed only one-way auto traffic, the German traffic code was changed on September 1, 1992, to formally allow the construction of bicycle streets. Accompanying the legal status were conditions that a street must meet before it could be designated as a bicycle street. These included the following:

- Bicycles must be the dominant form of traffic or expected to be the dominant form of traffic.
- Bicycle streets must be clearly marked and recognizable as bicycle streets.
- If a street is to be designated as a bicycle street, all other traffic must only be allowed under exceptional circumstances and, when possible, limited to those who live on and around the street.
- Measures must be taken to slow down traffic and allow for cars to park safely.
- The beginning and end of the bicycle street must be marked by design features that provide as little room as possible for cars to enter or exit. These design features could include raised road surfaces or a narrowed road width. This applies to side entrances to the bicycle street as well. (Lehner-Lierz, 2002)

The change in the traffic code provided not only legal status to the bicycle street in Germany but also guidelines for limiting automobiles that ensured that bicycle streets would serve cyclists.

It also provided a set of conditions that contained enough ambiguity to support the arguments of both those in favor of and opposed to a given bicycle street proposal. Possibly for this reason, bicycle streets have not become a common solution in Germany for solving bicycle network connectivity problems (Lehner-Lierz, 2002).

4.2. Bicycle streets in Belgium

The bicycle street came later to Belgium than Germany, but its path from experimental form to legalized section of the traffic code was short and straightforward. In 2011, the city of Ghent implemented the first bicycle street in Belgium. The intention was to improve a section of a main bike route connecting two neighborhoods of the city by using a bicycle street in a location where low levels of traffic made the potentially prohibitive expense of separated infrastructure unnecessary. The implementation of the bicycle street had noticeable and positive results. A comparison of street traffic between 2010 and 2012 showed a doubling in the number of cyclists during the morning rush hour. Auto traffic on the street during that same period dropped by 25% (Het Laatste Nieuws, 2012). In the same year, 2011, a second bicycle street was implemented in Ghent and this street also saw an increase in bicycle traffic and a decrease in auto (Belga News Agency, 2012; Triflex, 2013).

Based on the success of these two pilots, Belgium implemented a law in December 2012 that gave the bicycle street a formal place in Belgian traffic code. The Belgian law did not contain the conditional requirements of the German traffic code. Rather, it defined a bicycle street by two simple rules: autos on a bicycle street cannot go faster than 30 km/h and they cannot pass bicycles (Belga News Agency, 2012). The law also designated official signs to mark the beginning and end of the bicycle street (Lemmens, 2012). While no official count exists for the number of bicycle streets currently in Belgium, by 2015 at least six other Belgium cities had adopted the concept (Fietsberaad Vlaanderen, 2015).

The Belgium regulations have the same purpose as the German regulations: supporting a change in cycling practice from biking on the side of the street to biking in the center. They attempt to accomplish this purpose, however, in a very different manner. The German regulations focus primarily on demanding infrastructure elements that will slow down and reduce the number of autos. The Belgian regulations focus on using legal protections to empower cyclists to use the center of the street, but do not regulate the form of the infrastructure itself. As described by Bruno Latour in the essay, “Technology is society made durable,” this ignores the complex interrelationship between material infrastructure and social superstructure (Latour, 1990). The regulations clarify the expected behavior of people who drive on the street, but do not provide any mean for promoting this behavior through infrastructure, design or process elements that would lead to a reduction in the speed or number of autos. The limited protections provided by Belgian regulations, however, are still more expansive than those in the Netherlands, where the traffic regulations provide no protections at all.

4.3. Bicycle streets in the Netherlands

While the implementation of bicycle streets in Germany and Belgium came from a need for a low-cost solution for connecting segments of the bicycle network, bicycle streets were introduced in the Netherlands for a quite different purpose. When the redesigned Burgemeester Reigerstraat in Utrecht opened again to traffic in 1996, it became the first bicycle street in the Netherlands (De Kruijff, 2017). The street, a section of commercial road on a heavily travelled bicycle route between the city center and Utrecht University, had capacity problems with all of the bicycle, pedestrian, bus and auto traffic on the road. Widening the bike lanes or making the street one way would help, but shop owners were against any solution that limited auto access or removed car parking (Determeijer, 1997). After

a series of meetings with those who lived on and near the street, the city made the decision to narrow the lanes of the street and put up a sign that designated the street as bicycle street (Goldenbeld and Van Schagen, 1997). The purpose of the bicycle street, therefore, was to accommodate bicycles in a way that would allow the preservation of auto access rather than limit it.

The bicycle street did not last long, however. Cyclists felt endangered by the large number of cars and buses driving directly behind them (De Kruijff, 2017). Many would reflexively ride on the sides of the street instead of asserting their position in the middle. Trucks in the processes of loading or unloading would block auto traffic. Cyclists would then move to the sidewalk which led to complaints from shop owners on behalf of their customers. After numerous complaints, the police evaluated the situation and believed making the street one way for auto traffic would solve nearly all the issues. This solution, however, was politically unfeasible because shop owners saw this as limiting the number of people who would be able to reach their stores by car, suggesting that the willingness to implement the bicycle street was depended on the retention of auto access in its design. The city tried to address the problems by forbidding cars to pass cyclists and conducting a promotional campaign to encourage cyclists to ride in the center of the road (Determeijer, 1997). These efforts, however, were not sufficient to diminish the complaints, and the bicycle street that cost approximately €300,000 to construct was dismantled just two years after it opened (De Kruijff, 2017).

While the first bicycle street in the Netherlands only lasted two years, the bicycle street concept itself persisted. At the end of 1996, Delft University of Technology published the first design guidelines for bicycle streets in the Netherlands. Rather than using the Utrecht example as a starting point, the study looked at mixed traffic streets in The Hague and Tilburg where high levels of cyclists and low levels of auto traffic gave cyclists the dominant position on the street. While these streets were not designed or labeled as bicycle streets, in practice they served the same function. The report then looked at the history and design of German bicycle streets and identified two key elements that needed to be taken into account in considering the use of the German design in the Netherlands: the Netherlands has a much higher level of cycling than Germany, resulting in changes in how and when autos are able to pass cyclists; and drivers in the Netherlands, according to the report, are less likely to change their behavior because of an advisory traffic sign and therefore the bicycle street should only be used in areas where auto traffic can be severely restricted (Andriesse and Hansen, 1996).

At the time of the report in 1996, at least five Dutch cities were seriously considering implementing bicycle streets in their communities (Andriesse and Hansen, 1996). In the years since the 1996 report, the number of bicycle streets in the Netherlands has grown dramatically. Research done as part of a master thesis in 2013 estimated that there are now several hundred bicycle streets in the Netherlands. The research also concluded that many cities have no bicycle streets and most people using the Dutch transportation system are not familiar with them (Delbressine, 2013).

Since the first bicycle street arrived in the Netherlands, numerous studies and reports have been published that describe the many different forms that bicycle streets can take and the safety implications of implementing bicycle streets in different contexts. All of the reports share one conclusion: reducing auto traffic improves safety and satisfaction on a bicycle street (Andriesse and Ligtermoet, 2005; Andriesse et al., 2001; CROW, 2016; Godefrooij and Hulshof, 2017; Mansvelder et al., 2013). The results of these studies, however, are not reflected in the legal definition of a bicycle street. This is because unlike in Germany and Belgium, the bicycle street in the Netherlands has no legal definition. Similar to the Dutch approach to marijuana (Joffe and Yancy, 2004) and prostitution (Bindel and Kelly, 2003), bicycle streets are tolerated, but not strictly legal (Fietsberaad Vlaanderen, 2015). The regulatory agency that deals with traffic laws in the Netherlands has determined that a street can have signs with the designation “bicycle street” with the understanding that these serve the function of informing road users, not regulating them (CROW-Fietsberaad, 2016). This flexibility in the design and location of bicycle streets allows them to be used for multiple purposes, including the preservation of auto access on streets with high levels of bicycle and auto traffic (Delbressine, 2013).

Allowing individual communities complete influence over the design also means that protections of user practices upon which the innovation depends may be lost in the consensus building process of collaborative governance. The section that follows details the one such collaborative governance process that occurred with the implementation of the Kruisstraat Bicycle Street in Eindhoven. It describes how the city developed this process and how it led to a design that many stakeholders, and particularly those who cycle on the street, came to see as flawed even as they acknowledged that the design had their support at the time of implementation.

5. The development and implementation of a bicycle street on the Kruisstraat in Eindhoven

5.1. A brief history of the Kruisstraat

The Kruisstraat in Eindhoven first opened as a shopping street in the mid-1950's (Stichting Eindhoven in Beeld, 2007). Before its redesign, it had a dedicated bicycle lane for those travelling south and mixed bicycle and car traffic for those travelling north (see Fig. 1).

The Kruisstraat is located in the neighborhood of Oud-Woensel (see Fig. 2). In 1997, this neighborhood had the highest rates of poverty in the city of Eindhoven and was designated as an area in need of improvement. This resulted in the city council of Eindhoven approving a multi-year renewal plan for the neighborhood in December of 2000. The redesign of the Kruisstraat was a part of this renewal plan (Project Group Oud Woensel, 2008).

In order to realize this renewal, the city of Eindhoven entered into a governance arrangement with the Eindhoven real estate company Domein, the owner of around 400 residences in the Oud-Woensel neighborhood. In 2004, the two parties signed an agreement of intention around the redevelopment concept. Domein would pay the costs surrounding the renewal of its own properties and the development of new property. The city reserved 4.5 million Euros for projects that improved the public space in the neighborhood and also received €817,000 from the Ministry of Housing, Spatial Planning and the Environment to cover the costs of preparing the area for renewal (Project Group Oud Woensel, 2008).

5.2. Redevelopment of the Kruisstraat

Domein and the city decided that an interactive planning approach was necessary, holding the belief that the most important sources of information about the neighborhood were in the neighborhood itself (Project Group Oud Woensel, 2008).

In order to develop this framework, the two main parties hired the architecture and city planning firm Buro 5 Maastricht to create guidelines for a planning process that would include the active participation of the neighborhood's residents and business owners (Project Group Oud Woensel, 2008). The process structure ultimately chosen involved the creation of a large number of participation groups with a particular conceptual theme surrounding each group. Each group had its own process structure and its own leader.

A coordination group made up of members from the professional planning organization, shop owners union, and residents organizations determined what would be covered within each of the sub-groups (RIGO Research en Advies BV, 2011). The coordination group created two different sub-groups to cover the redevelopment of the Kruisstraat: one group discussed quality of life issues on the Kruisstraat and met three times per year; another group discussed the specifics of the redevelopment of the Kruisstraat and met six times per year (RIGO Research en Advies BV, 2011). Being an active participant required attending an evening meeting every month for two years (RIGO Research en Advies BV, 2011). This high level of commitment necessary to participate in the process suggests that the group would be more likely to be comprised with those with a high level of concern about the outcome, rather than a representative sample of the stakeholders effected by the decisions.

Fig. 1. On the north end of the Kruisstraat looking south in August 2008.
Photo from Google Streetview.

The design of the Kruisstraat itself came about after a particularly intensive collaborative process. The first re-design plan for the Kruisstraat was developed entirely by the city, without input from the community. The original plan called for a restoration of part of the original market space as a car free zone and preventing through traffic by cutting off access for automobiles to the arterial road just north of the Kruisstraat (RIGO Research en Advies BV, 2011). While the residents approved of this plan, the business owners strongly objected, believing that the lack of through traffic for automobiles would make their business less visible and less accessible to potential customers (interview with E. Steenkamp, Kruisstraat Redevelopment project manager, on November 9, 2017). The project manager agreed to start the planning process again with meaningful input from the community (RIGO Research en Advies BV, 2011).

In 2009, a community group was formed to provide information and advice about the restructuring of the street. Being a member of the new community group required an even greater level of commitment than one for the original plan, with participants volunteering time on a nearly daily basis (RIGO Research en Advies BV, 2011). The process involved the residential, commercial and civic organizations active in the neighborhood (City of Eindhoven, 2008a) (see Appendix B for a complete list of groups and organizations invited to participate in the Kruisstraat redevelopment).

Following the idea that collaborative governance works to achieve consensus among all involved stakeholders (Ansell and Gash, 2008), the new plan received support from the entire group, with the exception of one business owner (Strik, 2009). The former market on the northern end of the street would remain a parking lot, one way through traffic would be permitted to the northern arterial and two way traffic into the parking lot, and the Kruisstraat would become a bicycle street (Steenkamp, 2009a) (see Fig. 2). In practice, this compromise allowed the Kruisstraat to continue to function as a through route for autos, with a 2015 study that separated origin, destination and through traffic showing an average of 3500 autos per day using the street, with an average of 300 per day using the street as a through route (Dufec, 2015a). The masterplan allowing this new design was formally adopted by the city on January 28, 2008 (City of Eindhoven, 2008b).

5.3. Bicycle street implementation, complaints and adjustments

The renovated street was opened in two stages, with the northern half completed in July 2011 and the southern section scheduled for completion in November 2011 (Dichtbij, 2011; Fietser is Koning in Kruisstraat, 2011). A month after the street opened, the city acknowledged that the street was not functioning as intended and bicycle traffic was not being given priority over motorized traffic on the street (Mobiliteit and RO, 2011). A year after the street opened, a member of the local conservative and suburban-based political party CDA wrote a formal letter to the city requesting the city acknowledge reports of dangerous and hostile encounters between cyclists and motorists on the street and asking for a justification for the street's unusual design (Weijs, 2012).

In response to the complaints, the city adjusted the street signage and design. It hung banners on both ends of the street in order to inform users that bicycles had priority. Authorities also added large bicycle symbols to the pavement to make clear to cyclists that they should use the center area and not the edges (Mobiliteit and RO, 2011) (see Fig. 3).

While the new bicycle symbols reflected an effort to communicate to cyclists that they should use the center of the road and not the edges, the markings did not solve the safety concerns created by the large amount of auto traffic on the street, parking spots along the length of the bicycle street, and use of the street for the unloading and loading of store trucks, all of which were necessary elements of the compromise over the street design (see Fig. 4). Complaints over these elements led to a study of the street by the Eindhoven Police Department and in 2015 they declared the street to be unsafe (Politie Eindhoven, 2015). In response, the police increased enforcement of traffic laws on the street. An enforcement action in 2017 resulted in 17 tickets being written over a 2 hour period, with one driver being measured at 64 km/h (Studio 40, 2017). According to at least one unscientific online poll conducted by a local newspaper, the enforcement actions failed to change user perceptions of the street. In June of 2016, these respondents voted the Kruissstraat the worst street in Eindhoven (De Natris, 2016).

5.4. Evaluating how cyclists use the Kruisstraat

While police concerns and suggestions of public dissatisfaction may indicate a bicycle street is not functioning effectively, traffic engineers such as Hans Monderman have argued that a certain level of discomfort is necessary in a shared space in order to ensure that those using it pay attention to their surroundings (Clarke, 2006). Reported stress, however, is not the only indication that a bicycle street is not functioning properly, as problems with a bicycle street can also be evaluated through direct observation. The defining element of a bicycle street is not the color of the pavement or the signs that mark its beginning and end, but rather the manner in which it reverses the traditional yielding relationships between those driving and those cycling: people cycling are expected to maintain their lane position in the center of the road with the cars behind them slowing to the speed of the cyclist. On the Kruisstraat, this idea is conveyed through the symbol of the person on a bicycle in the center of the lane (Fig. 3). A street designated as a bicycle street, but in which cyclists ride on the side of the street in order to yield to automobile traffic, is no different, in practice, from a traditional street without bicycle infrastructure.

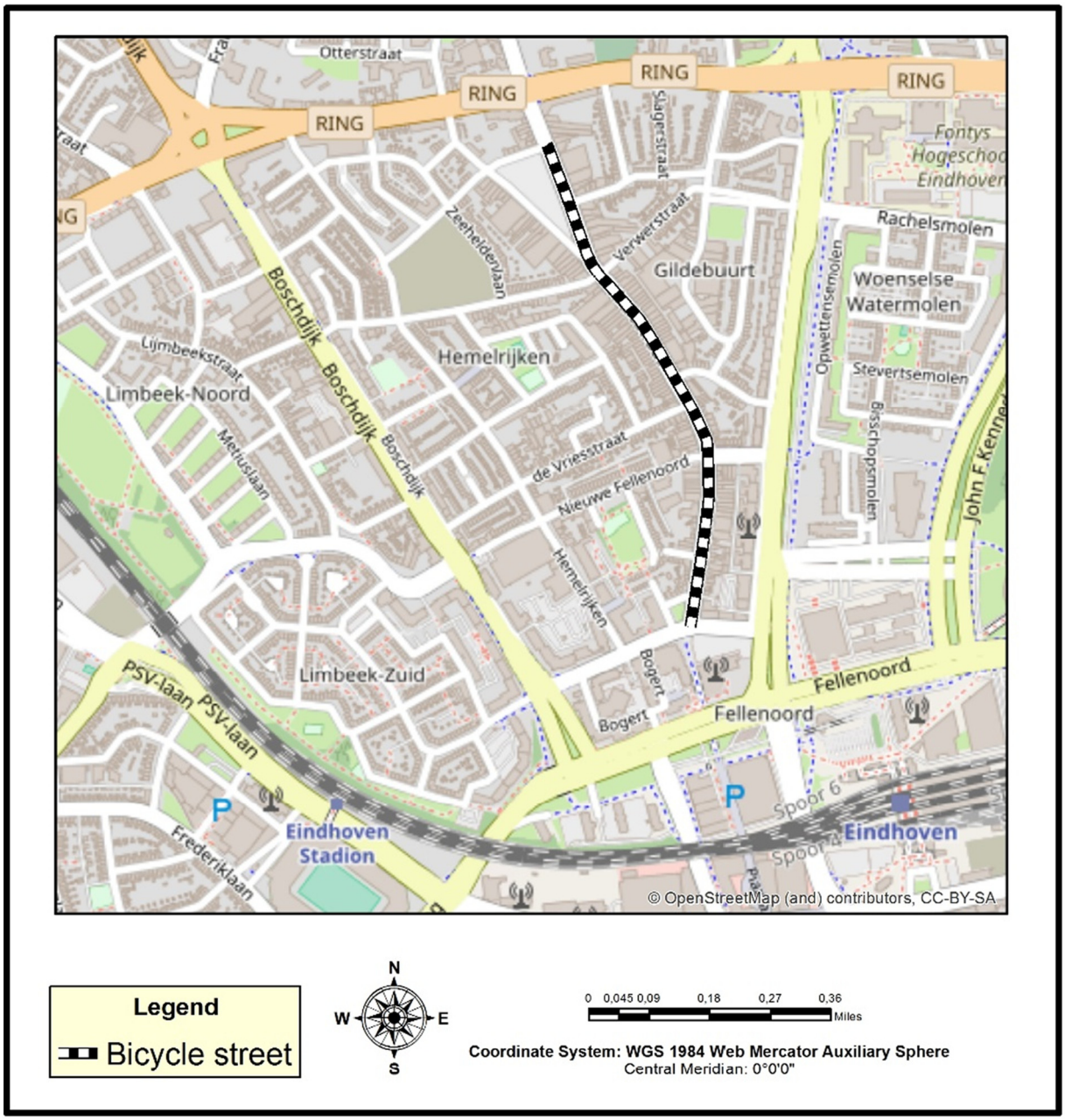

Fig. 2. The bicycle street on the Kruisstraat in Eindhoven.
Map adapted by the author from OpenStreetMap.

In order to determine if the Kruisstraat is functioning effectively as a bicycle street, three locations along the street were observed for 1 h, with each location being visited two times. At each of these locations, the city had painted an indicator for where cyclists should ride (see Fig. 3). The number of cyclists who followed this indicator were counted by observing if they either rode over the image of the cyclist or to its left. Cyclists who rode on the shoulder of the road, intended as a loading area (Dufec, 2015b), or who rode to the far right of the lane (to the right of the image of the cyclist) were also counted.

This process revealed that 79% of people who cycle on the street were riding either on the shoulder or to the far right of the lane. Only 21% rode in the center of the lane in a manner that would result in approaching automobile traffic having to yield to them. The maximum variance for the same road position between any two counts was 10% (see Appendix C for a more detailed description of the process and the data).

A possible explanation for the large number of cyclists not asserting their right of way over people driving could be that most people who cycle have the habit of biking to the far right even if a bicycle street is designed to promote riding in the center of the lane. As a control, therefore, observations were also conducted on another bicycle street in Eindhoven, one with minimal car traffic. On this street, only 9% rode on the far-right side of the lane, with a full 91% riding in the center (see Appendix C for the complete count data).

The safety concerns expressed by the Eindhoven police, the cyclists' complaints documented in newspaper reports and city meetings, and the quantitative counts showing the frequency of cyclists yielding to cars all suggest that Kruisstraat's redesign as a bicycle street has not been in service of the stated goal of a bicycle street: improving the cycling network to encourage people to cycle. The discussion section that follows provides possible explanations for why an innovation that requires protections for user

Fig. 3. Bicycle markings on the Kruisstraat pavement.
Photo taken by the author on September 23, 2019.

Fig. 4. Trucks preparing to unload on the Kruisstraat.
Photo taken by the author on March 7, 2017.

practices is not the best choice in collaborative governance processes where stakeholders have opposing goals. It also discusses the potential of regulatory guidelines to ensure these types of innovations are not implemented in situations where user practices cannot be adequately supported.

6. Discussion

The fundamental innovation of a bicycle street is that it changes the established power relationship between automobiles and bicycles. Accomplishing this involves more than simply putting up a sign or changing the color of the pavement. The literature on successful bicycle streets describes the importance of limiting automobile access (Andriesse et al., 2001), removing parking places (CROW-Fietsberaad, 2016), and ensuring that the number of bicycles using the street far outweighs the number of automobiles (Godefrooij and Hulshof, 2017). All of these elements empower the cyclists to maintain their position in defiance of the standard practice of yielding to car traffic. This is key to the success of the innovation. As discussed in strategic niche management literature, the successful adoption of an innovation can be put into jeopardy when the innovation requires a change in existing user practices (Smith and Raven, 2012). If cyclists are not supported in changing their practices and yield to cars on a bicycle street, the innovation has failed, as the bicycle street becomes no different from any ordinary street.

Supporting the necessary change in user practices, therefore, is key to the success of a bicycle street. In Germany, the specific auto restricting elements that support this change have been codified in the regulations governing the establishment of bicycle streets, dictating not only the conditions of implementation, but the specific group that they should serve; the regulations state that bicycles must become the dominant form of traffic (Lehner-Lierz, 2002). In the Netherlands, however, no such regulations exist. With the bicycle street having no specific legal designation in the Netherlands, every community in which it is implemented decides on its own which issues a bicycle street should address and to what degree, or even if, auto traffic should be limited. The lack of legal status means that there is no legal definition of a bicycle street, which allows stakeholder pressure to turn an innovation created to expand the bicycle network for cyclists into an innovation used to maintain access for autos.

Not all bicycle streets in the Netherlands are used to maintain auto access. Successful bicycle streets in residential areas reflect a shared purpose between residents and cyclists (CROW-Fietsberaad, 2016). Restrictions on autos are accepted because fewer cars benefit both groups. Fewer cars creates a safer, quieter neighborhood for residents. Fewer cars create a safer, better functioning bicycle street for cyclists. While there may be a degree of negotiation about the precise nature of the auto restrictions, substantially lowering the levels of auto traffic and parking is possible because it is in the interest of all parties involved(CROW-Fietsberaad, 2016).

When a bicycle street is installed in an auto accessible commercial area, however, the key stakeholders may no longer share the same harmony of interests or the same intentions. The Kruisstraat example reflects this. When the bicycle street came up as a suggestion for the commercial area of the Kruisstraat, it was not accepted because of how well it would improve the cycling network of Eindhoven. The bicycle street was suggested after the neighborhood rejected a plan that involved closing off the neighborhood to through traffic and removing parking spaces (Project Group Oud Woensel, 2008). The community recognized that the situation for cyclists needed to be improved, but did not accept the trade-offs in auto access necessary to improve it. The bicycle street here served a different purpose than one in residential areas; it became a tool to preserve auto access rather than a tool to limit auto access and empower cyclists. This is clearly reflected in the terms that were set before the design of the bicycle street was discussed.

The city made a commitment to the neighborhood businesses that not a single parking space would be lost in the redesign process. The city commissioned a study before the project began to count the number of parking spaces in order for this promise to be verifiable (Project Group Oud Woensel, 2008). The bicycle street proposal also involved a removal of the restriction on through traffic present in the original design. While most of the street would become one way for cars, the northern side of the street would remain open for both through traffic and access to the parking lot on the northern end of the street (Deschesne and Bootsma, 2012).

Because a bicycle street allows autos and bicycles to share the same space, it seems like an ideal compromise solution in areas where space concerns do allow separate lanes for bicycles and cars. This compromise only works for people who cycle, however, if they receive enough support to change their practices and maintain their position in front of cars on the street, and this requires limiting auto access rather than preserving it.

Without clear definitions and regulations for what a bicycle street is, collaborative governance processes that involve compromises with shop owners can lead to a loss of the auto restricting elements that make a bicycle street attractive for cyclists. This can be seen as a question of who is perceived as owning the street. Approximately 6000 cyclists make use of the Kruisstraat every day (Dufec, 2015b). The redesign process for the street, however, was seen as something owned by the neighborhood (RIGO Research en Advies BV, 2011) rather than by the people who use it as part of their cycling route.

When some stakeholders want a bicycle street only because they object to other solutions that are more restrictive for autos, the choice for how to design the bicycle street becomes not one of how to limit auto access the highest degree possible, but rather how much auto traffic and parking can be maintained and still meet minimum safety requirements.

Because bicycle streets have no legal status and no legal requirements, each community must decide on their own what those minimum safety requirements are. The city of Eindhoven looked at other existing bicycle streets in the region, but all of these were bicycle streets in residential areas (interview with E. Steenkamp, Kruisstraat Redevelopment project manager, on November 9, 2017). The first bicycle street in the Netherlands, which failed after experiencing problems similar to those seen on the Kruisstraat, had been dismantled over ten years earlier (De Kruijff, 2017). The use of a bicycle street in a commercial area was also not taken lightly by the shop owners or residents, with the meeting minutes reflecting a clear statement of concern for the risks by those involved (Steenkamp, 2009b). The city and the stakeholders attempted to assess the risk and make choices based on that assessment. With numerous bicycle streets present in the Netherlands and a nearly 20 year history of their use, however, this risk assessment is still left to individual cities that may have limited local examples of bicycle streets and limited resources to investigate experiences in other cities.

The city's chose to implement a bicycle street because it had a goal of finding the best possible solution that worked for all stakeholders (RIGO Research en Advies BV, 2011). The national government in the Netherlands has broader goals, which include increasing the number of kilometers cycled nationally by 20% between 2017 and 2027 (CROW, 2020). If some cities implement bicycle streets where they are not well suited and cyclists have a negative experience as a result, this could lead to resistance to bicycle streets in places where they might be weill suited to serve cyclists and could help with achieving national cycling goals. While cities may want the flexibilty to adapt bicycle streets to the demands of their stakeholders, it is harmful to the users in the specific location of implementation and potential future users in other locations when this flexibility comes at the cost of the user protections necessary for the innovation to be succusessful.

In the case of the bicycle street, implementing national regulations for restricting auto use could protect the practices of cyclists and prevent the implementation of bicycle streets where they are not appropriate. Just as the German and Belgian regulations addressed concerns specific to the contexts in which their bicycle streets were developed, regulations in the Netherlands should address bicycle streets being used as a means to preserve auto access. These regulations could be as simple as stating that a bicycle street should only be used on streets where low levels of auto traffic make separated infrastructure unnecessary and can only be implemented when all stakeholders agree to limiting auto traffic to the largest degree possible. These regulations would decrease the risk of potentially dangerous bicycle streets being implemented and provide boundaries for its use in the consensus building process, allowing other solutions to be agreed upon

when a bicycle street is not the most suitable alternative. While developing uniform design standards that make bicycle streets easily recognizable to all users could provide some support for cyclists' practices on bicycle streets, changing pavement colors and markings or adding additional signs does not address issues related to traffic volumes, and therefore are not likely to provide adequate protection to cyclists' practices on bicycle streets that have been implemented in order to maintain auto access.

7. Conclusion

This article examined the effect of local collaborative government processes on the implementation of user practice centered transportation innovations through an examination of the bicycle street. It explored the tensions between employing collaborative governance processes and supporting the new user practices necessary for the innovation to succeed.

Collaborative governance literature describes how meaningful citizen participation in decision making can lead to successful policy outcomes (Ansell and Gash, 2008; Thomas and Perry, 2006). Strategic niche management literature argues that innovations that require users to make substantial changes in their current practices have an increased risk of failure (Smith and Raven, 2012). This article described how the bicycle street, an innovation based on a change in how people who cycle ride on a mixed traffic street, reflects the possibility that a focus on consensus among potentially impacted stakeholders can overshadow consideration for how the users for which it was developed will adapt to it. This may result in the innovation having sufficient support to be implemented without being sufficiently attuned to new user practices, creating a negative experience of the innovation that serve as an obstacle to future upscaling.

The brief outline of the historical development and implementation of bicycle streets in Germany and Belgium showed how both those countries promoted the bicycle street as a means to complete bicycle networks in a cost effective manner, with efforts to protect the necessary cycling practices codified into law. This stands in contrast to the development of bicycle streets in the Netherlands, where the bicycle street was first used as a tool to accommodate both people who cycled and people who drove in situations where spacial and political constraints limited the possibilities for expanding separated infrastructure. Unlike in Germany and Belgium, the Netherlands has never adopted legally enforceable guidelines for bicycle streets, meaning that the form of each implementation is dependent upon the governance processes that lead to its creation.

The consequences of implementing bicycle streets without any clearly established guidelines was described in the account of the first bicycle street in the Netherlands and in the case of the Kruisstraat Bicycle Street in Eindhoven, the Netherlands. These examples illustrate how the consensus building goals of collaborative governance and can conflict with necessity for properly protecting user practices as described in strategic niche management. Empirical evidence from the Kruisstraat showed that the majority of the people who cycled on the street rode in a manner that allowed autos to have priority, suggesting that user practices were inadequately protected during the collaborative process that led to a consensus on the design of the street. The discussion section described how establishing specific regulations at the national level could provide the necessary protections for user practices in collaborative governance processes, with a specific recommendation of establishing regulations that limit the use of bicycle streets as a compromise tool for retaining auto access in space constrained areas.

CRediT authorship contribution statement

Matthew Bruno: Conceptualization, Methodology, Data curation, Formal analysis, Investigation, Visualization, Writing - original draft.

Acknowledgments

The authors would like to thank everyone who provided support in the development and revision of the article, including Frank Schipper, Ruth Oldenziel, the Sustainable Urban Mobility research team, the members of the Eindhoven Cyclists' Union, and all of the people who took time out of their busy schedules to discuss the complexities of bicycle streets with me. The author assumes responsibility for all errors.

Funding

This work is part of the VerDuS programme Smart Urban Regions of the Future with project number 438-15-160 which is (co)financed by the Dutch Research Council.

Appendix A. Primary sources for the eindhoven bicycle street governance process

Meeting minutes and presentations

Presentation by the Old Woensel Neighborhood Renewal Committee on the Redesign of the Kruistraat/Woensel Market, November 3, 2008
Minutes from the Third Meeting of the Working Group for the *Re*-design of the Kruisstraat/Woensel Market, March 2, 2009
Minutes from the Fourth Meeting of the Working Group for the Re-design of the Kruisstraat/Woensel Market, July 13, 2009
Minutes from the Working Group for the Re-design of the Kruisstraat/Woensel Market, December 8, 2008
Minutes from the Theme Group meeting for the Re-design of the Kruisstraat/Woensel Market, April 20, 2009
Minutes from the Theme Group meeting for the Re-design of the Kruisstraat/Woensel Market, May 25, 2009
Responses to submitted questions in advance of the information session on July 22, 2009
Minutes from the Woensel Market Working Group, June 9, 2011
Minutes from the Woensel Market Working Group, April 16, 2012
Minutes from the Woensel Market Working Group, June 17, 2013

Reports

Old Woensel Project Group Redevelopment Master Plan, February 2008
10 Years of Integrated Renewal Planning, Eindhoven: Old Woensel, January 2011
City of Eindhoven Land Use Plan: Oud Woensel, November 2012
Dufec Data Collection and Management, Traffic Research on the Eindhoven Kruisstraat, February 2015
Dufec Data Collection and Management, Traffic Research on the Eindhoven Kruisstraat, October 2015

Interviews

P. Plantinga, Eindhoven Cyclists' Union Representative for the Working Group for the Re-design of the Kruisstraat/Woensel Market, interviewed on July 3, 2017
H. van der Steenhoven, former head of the Dutch Cylists' Union and City Councilperson during the development of the Burgemeester Reigerstraat Bicycle Street in Utrecht, Interviewed on July 31, 2017
E. Steenkamp, Kruisstraat Redevelopment project manager, interviewed on November 9, 2017

Appendix B. Community group members involved in the original redevelopment plan for the Kruisstraat, from the city of Eindhoven's "Communication Plan for the Redevelopment of the Kruisstraat and Woenselse Markt,"2008

Dutch name	English translation	Represented group
Winkeliersvereniging Winkelhart Oud Woensel (WOW)	Old Woensel Commercial Shopping Center Association	Business owners
Centrale Vereniging voor Ambulante Handel (CVAH)	Central Association for Mobile Businesses	Operators of stalls at the Woensel Market
Bewoners(organisatie) Woenselse Markt	Resident Organization Woenselse Markt	Residents of the Woenselse Markt neighborhood
Bewoners(organisatie) Hemelrijken	Resident Organization Hemelrijken	Residents of the neighborhood Hemelrijken
Bewoners(organisatie) Kronehoef	Resident Organization Kronehoef	Residents of the neighborhood Kronehoef
Bewoners(organisatie) Vredesplein e.o.	Resident Organization Vredesplein	Residents of the neighborhood Vredesplein
Bewoners(organisatie) Bakkerstraat	Resident Organization Bakkerstraat	Residents of Bakker Street
Vereniging Oud Woensel	Oud Woensel Association	Social club for the Old Woensel neighborhood
Initiatiefgroep Nieuw Oud Woensel (NOW)	Action Group New Oud Woensel	Resident organization in the Oud Woensel neighborhood formed in response to the renewal plans
Eindhoven Politie	Eindhoven Police	Eindhoven police
Eindhoven Fietsersbond	Eindhoven Cyclists' Union	People who cycle in Eindhoven
Platform Gehandicapten Eindhoven	Eindhoven Platform for People with Disabilities	People in Eindhoven with disabilities
Gemeente Eindhoven	The City of Eindhoven	The City of Eindhoven

Appendix C. Eindhoven bicycle streets evaluation process and results

Six one-hour observation periods were used to determine if people riding bicycles on the Kruisstraat bicycle street were asserting their priority on the street and treating cars as guests. In three locations along the street, the city painted an outline of a person riding a bicycle in the center of the lane in both directions in order to indicate where cyclists should be riding. The number of cyclists who either rode over part of the image of the cyclists or to the left of this image were counted. Cyclists who rode in the shoulder of the road – intended as a loading area – or who rode on the very edge of the street, to the right of the image of the cyclists, were also counted. The shoulder extends 103 cm from the curb, the image of the cyclists begins 59 cm from the shoulder, and the remainder of the lane is 133 cm. The observations, therefore, counted the number of cyclists either riding in the shoulder, riding on the right 1/3 of the lane (edge), or riding in the left 2/3 of the lane (center) for both southbound (S) and northbound (N) traffic. The three columns on the right show the percentage of cyclists in each location as a combined total of north and southbound bicycle traffic.

As a control, observations were also conducted on another bicycle street in Eindhoven. Because this bicycle street has no shoulder, these columns are blank. The edge measurement remained 59 cm with the remainder of the lane totaling 292 cm.

Table A.1
Date, time, location and position information for the bicycle street counts.

Date	Time	Location	S shoulder	S edge	S center	N Center	N edge	N shoulder	Center	Edge	Shoulder
15-7-2019	17:00–18:00	18 Woenselse Markt	79	148	90	91	195	91	20,51%	54,58%	24,92%
17-7-2019	17:00–18:00	78 Kruisstraat	87	211	83	84	286	96	18,19%	56,72%	25,09%
18-7-2019	17:00–18:00	144 Kruisstraat	135	181	27	109	267	100	16,61%	54,70%	28,69%
10-10-2019	17:00–18:00	18 Woenselse Markt	76	188	82	173	225	69	28,56%	50,96%	20,48%
9-10-2019	17:00–18:00	78 Kruisstraat	119	212	48	133	299	87	20,16%	56,90%	22,94%
17-10-2019	17:00–18:00	144 Kruisstraat	108	177	29	156	235	83	23,48%	52,28%	24,24%
23-9-2019	17:00–18:00	80 Leenderweg		2	5	130	11		91,22%	8,78%	

References

Andriesse, H.C., Hansen, J.A., 1996. De fietsstraat: Onderzoek naar fietsverbindingen door verblijfsgebieden [The Bicycle Street: Research over Bicycle Connections Through Residential Areas] (Delft).

Andriesse, R., Ligtermoet, D., 2005. Fietsstraten in hoofdfietsroutes: Toepassingen in de praktijk [Bicycle Streets on Primary Bicycle Routes: Practical Applications]. 6. Fietsberaad Retrieved from. http://www.fietsberaad.nl/library/repository/bestanden/document000101.pdf.

Andriesse, R., Rinkel, L., De Klein, L., De Bruin, D., 2001. Wacht u voor de fiets: Fietsstraten op een rij [Wait for the Bicycle: Bicycle Streets in a Row]. 1. Verkeerskunde, pp. 18–22 Retrieved from. http://www.fietsberaad.nl/library/repository/bestanden/VKFietsstraten.pdf.

Ansell, C., Gash, A., 2008. Collaborative governance in theory and practice. J. Public Adm. Res. Theory 18 (4), 543–571. https://doi.org/10.1093/jopart/mum032.

Arnstein, S., 1969. A ladder of citizen participation - Sherry R Arnstein. JAIP 35 (4), 216–224 Retrieved from. http://lithgow-schmidt.dk/sherry-arnstein/ladder-of-citizen-participation_en.pdf.

Ballast Nedam, 2016. Ontwerp en bouw van fietsbrug en natuurverbinding [Design and construction of the bicycle bridge and nature connector]. Retrieved May 15, 2017, from. http://www.ballast-nedam.nl/projecten/ontwerp-en-bouw-van-fietsbrug-en-natuurverbinding/.

Barter, P., 2009. Earning a Public Space Dividend, (May), 32–39.

Belga News Agency, 2012. Wet op de fietsstraten treedt in werking [Law over bicycle streets comes into effect]. Retrieved October 24, 2017, from. http://www.knack.be/nieuws/belgie/wet-op-de-fietsstraten-treedt-in-werking/article-normal-75675.html.

Bindel, J., Kelly, L., 2003. A Critical Examination of Responses to Prostitution in Four Countries. Prostitution et Societe, Victoria, Australia; Ireland; The Netherlands; and Sweden Retrieved from. http://www.prostitutionetsociete.fr/IMG/pdf/2003bindelkellycriticalexaminationfourcountries.pdf.

Booher, D.E., 2004. Collaborative governance practices and democracy. Natl. Civ. Rev. 93 (4), 32–46. https://doi.org/10.1002/ncr.69.

City of Eindhoven, (2008a). Communicatieplan herinrichting Kruisstraat en Woenselse Markt [Communication Plan for the Redevelopment of the Kruisstraat and Woenselse Markt].

City of Eindhoven. (2008b). Raadsvoorstel tot het vaststellen van het Masterplan Oude Woensel [Proposal to Adopt the Oude Woensel Master Plan].

Clarke, E., 2006. Shared space - the alternative approach to calming traffic. Traffic Engineering and Control 47 (8), 290 Retrieved from. https://www.scopus.com/record/display.uri?eid=2-s2.0-33846051917&origin=resultslist&sort=plf-f&src=s&st1=Shared+Space-the+alternative+approach+to+calming+traffic&st2=&sid=55ca5537712a3e917414672132bec1a2&sot=b&sdt=b&sl=71&s=TITLE-ABS-KEY%28Shared+Space-th.

CROW, 2016. Zo ziet een ideale fietsstraat eruit [This is what an ideal bicycle street looks like]. Fietsverkeer 39, 18–23 Retrieved from. http://www.fietsberaad.nl/library/repository/bestanden/Fv39_Fietsstraat.pdf.

CROW. (2020). Tour de Force. Retrieved from https://www.fietsberaad.nl/tour-de-force/home.

Davies, J.S., 2007. The limits of partnership: an exit-action strategy for local democratic inclusion. Political Studies 55 (4), 779–800. https://doi.org/10.1111/j.1467-9248.2007.00677.x.

De Kruijff, N. (2017). "Niet weer een fietsstraat alsjeblieft." [Please not another bicycle street.] Retrieved November 3, 2017, from https://www.ad.nl/utrecht/niet-weer-een-fietsstraat-alsjeblieft~ac488505/.

Albert de la Bruhèze, A. A., & Veraart, F. C. A. (1999). Fietsverkeer in praktijk en beleid: overeenkomsten en verschillen in fietsgebruik in Amsterdam, Eindhoven, Enschede, Zuid-Oost Limburg, Antwerpen, Manchester, Kopenhagen, Hannover en Basel [Bicycle Traffic in Practice and Policy: Similarities and Differences in Bicycle Use in Amsterdam, Eindhoven, Enschede, South East Limburg, Amsterdam, Manchester, Copenhagen, Hannover and Basel]. Ministerie van Verkeer & Waterstaat, Den Haag, 169. Retrieved from http://library.wur.nl/WebQuery/clc/965514.

de Natris, A. (2016). De Kruisstraat is volgens jullie de "slechtste straat van Eindhoven." [The Kruisstraat is, according to you, the 'worst street in Eindhoven'.] Retrieved May 18, 2017, from http://www.dichtbij.nl/eindhoven/112/artikel/4257867/de-kruisstraat-is-volgens-jullie-de-slechtste-straat-van-eindhoven-.aspx.

Delbressine, R.R.H.L., 2013. The traffic safety of bicycle streets in the Netherlands. Retrieved from. http://repository.tudelft.nl/islandora/object/uuid:f3861d56-2ab9-4e33-b597-35c27d8943b8/?collection=research.

Deschesne, F., Bootsma, T., 2012. Gebruikers positief over fietsstraat Kruisstraat [Users positive over the Kruisstraat Bicycle Street]. Ventiel 10 Retrieved from. https://s3-eu-west-1.amazonaws.com/fietsersbond/app/uploads/sites/43/2013/01/12130554/Ventiel-146-juni-2012.pdf.

Determeijer, B., 1997. "Gewoon denken: dit is mijn straat"; In "fietsstraat" moet de automobilist zijn tempo aan de fietser aanpassen [Just Think: This is My Street: On a 'Bicycle Street' the Driver Must Adjust Their Pace to the Cyclist]. NRC Handelsblad Retrieved from. https://www.nrc.nl/nieuws/1997/01/18/gewoon-denken-dit-is-mijn-straat-in-fietsstraat-moet-7339140-a93367.

Dichtbij. (2011). Fietsstraat Kruisstraat deels open na herinrichting[Kruisstraat bicycle street partially open after redesign]. Retrieved May 18, 2017, from http://www.dichtbij.nl/eindhoven/regionaal-nieuws/artikel/2491140/fietsstraat-kruisstraat-deels-open-na-herinrichting.aspx.

Dufec. (2015a). Verkeersonderzoek Kruisstraat Eindhoven, februari 2015 [Traffic Research Eindhoven Kruisstraat, February 2015].

Dufec. (2015b). Verkeersonderzoek Kruisstraat Eindhoven, oktober 2015 [Traffic Research Eindhoven Kruisstraat, October 2015].

Emerson, K., Nabatchi, T., Balogh, S., 2012. An integrative framework for collaborative governance. J. Public Adm. Res. Theory 22 (1), 1–29. https://doi.org/10.1093/jopart/mur011.

Fietsberaad Vlaanderen. (2015). Fietsstraten in Vlaanderen [Bicycle Streets in Flanders]. Retrieved from http://www.fietsberaad.be/Kennisbank/Bijlagen/Fietsberaad_folder_Fietsstraten_DEF.pdf.

Fietser is Koning in Kruisstraat [Cyclist is king in Kruisstraat]. (2011). Eindhovens Dagblag. Retrieved from http://www.ed.nl/eindhoven/fietser-is-koning-in-kruisstraat~aff01612/.

Fung, A., 2006. Varieties of participation in complex governance. Public Adm. Rev. 66 (Suppl. 1), 66–75. https://doi.org/10.1111/j.1540-6210.2006.00667.x.

Geels, F.W., 2012. A socio-technical analysis of low-carbon transitions: introducing the multi-level perspective into transport studies. J. Transp. Geogr. 24, 471–482. https://doi.org/10.1016/j.jtrangeo.2012.01.021.

Ghose, R., 2005. The complexities of citizen participation through collaborative governance. Space and Polity 9 (1), 61–75. https://doi.org/10.1080/13562570500078733.

Godefrooij, H., Hulshof, R., 2017. Toepassingsmogelijkheden Fietsstraten [Adaptive possibiilities of bicycle streets]. Nationaal verkeerskundecongres 2017 Retrieved from. http://nationaalverkeerskundecongres.nl/Uploads/2017/10/7-Toepassingsmogelijkheden-fietsstraten-Hans-Godefrooij.pdf.

Goldenbeld, C., Van Schagen, I.N.L.G., 1997. Video-evaluatie "fietsstraat" Utrecht [Video evaluation of Utrecht 'bicycle street']. Stichting Wetenschappelijk Onderzoek Verkeersveiligheid SWOV Retrieved from. https://www.swov.nl/sites/default/files/publicaties/rapport/r-97-28.pdf.

Hallenbeck, S., 2012. User agency, technical communication, and the 19th-century woman bicyclist. Tech. Commun. Q. 21 (4), 290–306. https://doi.org/10.1080/10572252.2012.686846.

Het Laatste Nieuws. (2012). Gentse "fietsstraat" leidt tot forse toename aantal fietsers [Ghent "bicycle street" leads to heavy increase in the number of cyclists]. Retrieved November 1, 2017, from https://www.hln.be/nieuws/binnenland/gentse-fietsstraat-leidt-tot-forse-toename-aantal-fietsers~a1d80648/.

Huxham, C., Vangen, S., Huxham, C., Eden, C., 2000. The challenge of collaborative governance. Public Management: An International Journal of Research and Theory 2 (3), 337–358. https://doi.org/10.1080/14719030000000021.

Ieromonachou, Petros, Potter, S., Enoch, M., 2004. Adapting strategic niche management for evaluating radical transport policies-the case of the Durham road access charging scheme. Int. J. Transp. Manag. 2 (2), 75–87. https://doi.org/10.1016/j.ijtm.2004.09.002.

Ieromonachou, P., Potter, S., Warren, J.P., 2006. Norway's urban toll rings: evolving towards congestion charging? Transp. Policy 13, 367–378. https://doi.org/10.1016/j.tranpol.2006.01.003.

Joffe, A., Yancy, W.S., 2004. Legalization of marijuana: potential impact on youth. Pediatrics 113 (6) Retrieved from. http://pediatrics.aappublications.org/content/113/6/e632.full#ref-6.

Kemp, R., Schot, J., Hoogma, R., 1998. Regime shifts to sustainability through processes of niche formation: the approach of strategic niche management. Technology Analysis and Strategic Management 10 (2), 175–195. https://doi.org/10.1080/09537329808524310.

Kenger, L., Schot, J., 2016. User-made immobilities: a transitions perspective. Mobilities 11 (4), 598–613. https://doi.org/10.1080/17450101.2016.1211827.

Krizek, K.J., Handy, S.L., Forsyth, A., 2009. Krizek, K.J., Handy, S.L., Forsyth, A., 2009. Explaining changes in walking and bicycling behavior: challenges for transportation research. Environ. Plan. B Plan. Des. 36, 725–740. https://doi.org/10.1068/b34023Explaining changes in walking and bicycling. Environment and Planning B: Planning and Design 36 (4), 725–740. https://doi.org/10.1068/b34023.

Latour, B., 1990. Technology is society made durable. Sociol. Rev. https://doi.org/10.1111/j.1467-954x.1990.tb03350.x.

Lehner-Lierz, U., 2002. Na twintig jaar nog steeds niet echt doorgebroken [After twenty years still no real breakthrough]. Fietsverkeer, 3, pag. 10-11. Retrieved from. http://www.fietsberaad.nl/?lang=nl&repository=Na+twintig+jaar+nog+steeds+niet+echt+doorgebroken.

Lemmens, L. (2012). Fietsstraat krijgt officieel verkeersbord [Bicycle street gets official traffic sign]. Retrieved October 24, 2017, from https://www.wegcode.be/actueel/1952-fietsstraat-krijgt-officieel-verkeersbord.

Mansvelder, E., Dijkstra, A., Delbressine, R., 2013. Fietsstraten getest op Duurzaam Veilig-principes: HOE VERKEERSVEILIG ZIJN FIETSSTRATEN? [Bicycle streets tested on the principles of sustainabiilty and safety: What is the traffic safety of bicycle streets?] Verkeerskunde. July Retrieved from. http://library.swov.nl/action/front/fulltext?id=338719.

Marletto, G., 2014. Car and the city: socio-technical transition pathways to 2030. Technol. Forecast. Soc. Chang. 87, 164–178. https://doi.org/10.1016/j.techfore.2013.12.013.

Mobiliteit & RO. (2011). Fietsstraat is nog even wennen [Bicycle street still requires some getting used to]. Retrieved May 18, 2017, from https://www.verkeersnet.nl/5735/fietsstraat-is-nog-even-wennen/.

Newman, J., Barnes, M., Sullivan, H., Knops, A., 2004. Public participation and collaborative governance. Journal of Social Policy 33 (2), 203–223. https://doi.org/10.1017/S0047279403007499.

Ogilvie, D., Bull, F., Powell, J., Cooper, A.R., Brand, C., Mutrie, N., ... Rutter, H., 2011. An applied ecological framework for evaluating infrastructure to promote walking and cycling: The iconnect study. American Journal of Public Health 101 (3), 473–481. https://doi.org/10.2105/AJPH.2010.198002.

Oldenziel, R., Albert de la Bruhèze, A., 2011. Contested spaces: bicycle lanes in urban Europe, 1900–1995. Transfers 1 (2), 29–49. https://doi.org/10.3167/trans.2011.010203.

Oldenziel, R., Emanuel, M., Albert de la Bruhèze, A., Veraart, F., 2016. In: Oldenziel, R., Emanuel, M., de la Bruheze, A. Albert, Veraart, F. (Eds.), Cycling Cities: The European Experience. Eindhoven.

O'Neill, J., 2001. Representing people, representing nature, representing the world. Environment and Planning C: Government and Policy 19 (4), 483–500. https://doi.org/10.1068/c12s.

Oudshoorn, N., Pinch, T., 2003. How Users Matter: The Co-construction of Users and Technologies. The MIT Press, Cambridge, Massachusetts.

Pitera, K.A., Mateo, C.E., 2014. Considering shared use bicycle facilities on narrow streets in Norway. In European Transport Conference, Frankfurt Retrieved from. https://trid.trb.org/view/1340869.

Politie Eindhoven. (2015). Onveilige Kruisstraat aangepast [Unsafe Kruisstraat adjusted]. Retrieved May 18, 2017, from https://nl-nl.facebook.com/PolitieEindhoven/posts/1157125350972887.

Project Group Oud Woensel. (2008). Integrale wijkvernieuwing Oud Woensel [Integrated neighborhood renewal Oud Woensel].

Raven, R., Van Den Bosch, S., Weterings, R., 2010. Transitions and strategic niche management: towards a competence kit for practitioners. Int. J. Technol. Manag. 51 (1), 57–74. https://doi.org/10.1504/IJTM.2010.033128.

RIGO Research en Advies BV. (2011). Tien jaar integrale wijkvernieuwing Eindhoven: Oud Woensel [Ten years of integrated neighborhodo renewal in Eindhoven]. Retrieved from http://eindhoven.notudoc.nl/cgi-bin/showdoc.cgi/action=view/id=163054/type=pdf/Bijlage_9_wijkvernieuwing_in_Eindhoven_Oud-Woensel.pdf.

Rogers, E., Weber, E.P., 2010. Thinking harder about outcomes for collaborative governance arrangements. American Review of Public Administration 40 (5), 546–567. https://doi.org/10.1177/0275074009359024.

Schaller, B., 2010. New York City's congestion pricing experience and implications for road pricing acceptance in the United States. Transp. Policy 17 (4), 266–273. https://doi.org/10.1016/j.tranpol.2010.01.013.

Schot, J., Geels, F.W., 2008. Strategic niche management and sustainable innovation journeys: theory, findings, research agenda, and policy. Tech. Anal. Strat. Manag. 20 (5), 537–554. https://doi.org/10.1080/09537320802292651.

Schot, J., Kanger, L., Verbong, G., 2016. The roles of users in shaping transitions to new energy systems. Nat. Energy 1 (May). https://doi.org/10.1038/nenergy.2016.54.

Shove, E., 2012. The shadowy side of innovation: unmaking and sustainability. Technology Analysis and Strategic Management 24 (4), 363–375. https://doi.org/10.1080/09537325.2012.663961.

Smith, A., Raven, R., 2012. What is protective space? Reconsidering niches in transitions to sustainability. Research Policy. https://doi.org/10.1016/j.respol.2011.12.012.

Song, Y., Preston, J., Ogilvie, D., 2017. New walking and cycling infrastructure and modal shift in the UK: a quasi-experimental panel study. Transp. Res. A Policy Pract. 95, 320–333. https://doi.org/10.1016/j.tra.2016.11.017.

Steenkamp, E., 2009a. Verslag derde bijeenkomst Klankbordgroep herinrichting Kruisstraat/Woenselse Markt [Minutes from the Third Meeting of the Working Group for the Re-design of the Kruisstraat/Woensel Market]. Gemeente Eindhoven, Eindhoven.

Steenkamp, E. (2009b). Verslag Themagroepbijeenkomst herinrichting Kruisstraat/WM. Eindhoven [Minutes from the Theme Group Meeting for the Re-design of the Kruisstraat/Woensel Market].

Stichting Eindhoven in Beeld, 2007. Opening winkels Kruisstraat [Opening of the Kruisstraat stores]. Retrieved May 18, 2017, from. http://www.eindhoveninbeeld.com/foto.php?foto=11233.

Strik, H., 2009. Verslag vierde bijeenkomst Klankbordgroep herinrichting Kruisstraat/Woenselse Markt [Minutes From the Third Meeting of the Working Group for the Re-design of the Kruisstraat/Woensel Market] (Eindhoven).

Studio 40. (2017). Twee uur controleren op de Kruisstraat: 17 boetes [Two hours of controls on the Kruisstraat: 17 fines]. Retrieved May 18, 2017, from http://www.studio040.nl/nieuws/40943-twee-uur-controleren-op-de-kruisstraat-17-boetes.html.

The Hague Office of Public Works. (1978). Demonstratie-Fietsroute Den Haag 1975–1979 [Demonstration bicycle route The Hague]. Den Haag. Retrieved from http://www.fietsberaad.nl/library/repository/bestanden/Demonstratiefietsroute Den Haag 1975–1979.pdf.

Thomas, A.M., Perry, J., 2006. Collaboration Processes: Inside the Black Box. Public Administration Review, Special Is.

Triflex BV. (2013). Project review: Fietsstraat Trekweg Mariakerke (Gent) [Project review: Bicycle street Trekweg Mariakerke (Ghent)]. Retrieved November 1, 2017, from https://www.slideshare.net/Architecturabe/triflex-project-review-fietsstraat-trekweg-gent.

van Buuren, A., 2009. Knowledge for governance, governance of knowledge: inclusive knowledge management in collaborative governance processes. Int. Public Manag. J. 12 (2), 208–235. https://doi.org/10.1080/10967490902868523.

Verma, A., Rahul, T.M., Dixit, M., 2015. Sustainability impact assessment of transportation policies - a case study for Bangalore city. Case Studies on Transport Policy 3 (3), 321–330. https://doi.org/10.1016/j.cstp.2014.06.001.

Weijs, C. (2012). Raadsvraag ontwerp fietsstraat Kruisstraat [Council questions on the design of the Kruisstraat bicycle street]. Retrieved May 18, 2017, from https://www.cda.nl/noord-brabant/eindhoven/actueel/nieuws/raadsvraag-ontwerp-fietsstraat-kruisstraat/.

Welzen, T. (2015). Fietsstraat [Bicycle street]. Retrieved May 18, 2017, from https://www.ensie.nl/tom-welzen/fietsstraat.

Zadek, S., Radovich, S., 2006. Governing Collaborative Governance: Enhancing Development Outcomes by Improving Partnership Governance and Accountability 28.