Adoption of Dutch Cycling Practices in The National Capital Region of India by Using Technological Innovation Systems Framework

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Executive Summary

Cycling is a type of recreational activity that is rarely utilized for everyday travel needs except in some countries such as the Netherlands. Health can be improved as a result of increased mobility, and by encouraging people to use public transit or cycles instead of their automobiles, traffic jams, and pollution may be reduced. The adoption of cycling in a populated and vast area like India's capital region will benefit the nation from the perspective of the economy and combating global warming. The research gap identified is that The National Capital Region of India is currently experiencing similar challenges as the Netherlands did years ago like road accidents, high traffic, and air pollution. It is crucial to pinpoint the requisite factors affecting the region's transportation preferences and the existing literature does not focus on the relevant issues from the perspective of relevant stakeholders or how these stakeholders have varied objectives when it comes to the adoption and expansion of the different modes of transportation. To investigate this, the Dutch cycling practices were chosen because the Netherlands is regarded as the best country in the world to cycle.

This leads to the research question of the thesis and that is *'What can the National Capital Region of India learn from the Dutch cycling practices with the participation of key stakeholders?'*. 14 semi-structured interviews were conducted with Dutch and Indian experts to collect relevant data. The Technological Innovation Systems (TIS) framework is used as the theoretical perspective in the thesis to analyze the data collected from the interviews and answer the research questions. The cycling success of Amsterdam and Copenhagen also helped in providing a conclusion and the results from the interviews are compared to see what India lacks when compared to the Netherlands with regard to the functions and structural dimensions of Technological Innovation Systems.

There were practical and meaningful insights from the findings of the research. The key ones which the Indian stakeholders can adopt are early learning for children, spreading awareness among people about cycling and its benefits, and political commitment. These factors mark the starting point for change and give the correct direction to the stakeholders to implement this change. It is imperative for children to learn about green transportation in their early life so they can understand numerous problems related to it like climate change and sustainability. This will also enable future generations to be more conscious and they will start demanding safe infrastructure for cycling. Politicians will then respond to public demands and create the necessary cycling infrastructure. Furthermore, policymakers can also adopt innovative ideas to make cycling a viable option for all social groups and try to change the perception of people towards cycling. The key findings from the research are interrelated in some or the other way as an action by a stakeholder can unfold an action by another stake-

holder and hence collaboration among stakeholders is also necessary.

The research had variety of constraints. Due to various restrictions, primarily, the most relevant factors that influence the choice of transportation were determined. Only interviews with experts were conducted, however, interviews with other people who are not experts but want to cycle or cycle regularly would have offered new insights. Regarding future recommendations, the findings from this research can be used to establish a methodical approach on how to improve cycling utilization in the Indian capital region and identify the key elements that are currently lacking. Alternatively, instead of comparing the Indian capital to an advanced nation, it may be beneficial to do so with an emerging nation or a city as it would allow Indian decision-makers to better grasp the needs of the people and act with limited resources.

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1 Introduction

This chapter provides a grasp of the research field and research objective along with research questions and research gap. It provides a better understanding of the problem domain. Section 1.1 discusses the background of the research, while section 1.2 includes how the research gap was identified and why it is important to promote non-motorized modes of transport in the National Capital Region of India. Section 1.3 includes the aim of the research and section 1.4 consists of the main research question and sub-research questions.

1.1 Research Background

For urban areas, road jams are a rising issue that results in polluted air, carbon discharge, and lengthy commutes. About a third of the carbon pollution of the OECD nations' entire economy is attributed to the transport industry (Savan, Cohlmeyer, & Ledsham, 2017). In OECD nations, the expenditure from bad air quality was valued at $1.7 trillion in 2010. Half of that expense is thought to be related to transportation (OCDE, 2014). This gives a significant possibility to adopt new forms of mobility. There is widespread agreement that a switch from cars to cycling as a mode of transportation, together with public transportation for extended journeys, would solve this issue and reduce the significant expenses associated with the environment, lifestyle, and lengthy commutes (Savan et al., 2017).

Across most of the world, cycling is a sporadic form of leisure that is seldom utilized for regular transportation requirements. In addition, cycling is sometimes highly unequally distributed in society, with males performing the majority of it, females cycling much less, and the aging population barely cycling whatsoever (Pucher & Buehler, 2008b). The popularity of more physically demanding modes of transport like cycling and walking has dramatically expanded in recent times. There are several positive aspects to having a large percentage of journeys made using such a form of mobility. Due to the higher rate of movement, it could improve health and by replacing cars with public transportation, it could also potentially lessen road congestion and related pollutants. Authorities have established targets for promoting such modes of transportation all around the globe (Ton, Duives, Cats, Hoogendoorn-Lanser, & Hoogendoorn, 2019).

In the 1970s, various protesting organizations were founded in the Netherlands as a result of an increasing incidence of road fatalities involving people who used cycles. Though people engaged in resistance tactics, their major focus was on how they serve

as an example of putting down the prowess, the notion that end users of innovation have a substantially distinct and useful viewpoint as compared to specialists (Dekker, 2022). According to Stoffers (2012), the Netherlands has the greatest rate of bicycle utilization among all nations. The Netherlands tops the list of cycling in European countries in terms of a variety of metrics, including bicycle possession, infrastructure, bicycle trip length for each person, as well as the proportion of journeys that include bicycles. As Varela (2021) and Deenihan and Caulfield (2014) pointed out, some of the merits are less traffic congestion, fewer carbon emissions, faster transit time for short distances, and economical in the light of rising fuel prices.

For those with modest incomes, cycling is an essential form of transportation. Cycling in India is experiencing significant change as a result of various perspectives on green transport and divergent actions done by them (Ghosh & Sharmeen, 2021). The final mile connection in Indian cities is in pathetic shape. The majority of cities lack adequate final mile connection infrastructure (De, Sikarwar, & Kumar, 2019). In India, bicycles are rapidly vanishing from daily existence and developed surroundings. The continuous prevalence of automotive mode reflects the social state apparatus by attempting to take up a bigger portion of street area. Most bikers in India are either low-wage employees or enrolled in education (Joshi & Joseph, 2015). As Akalkotkar (n.d.) pointed out, non-motorized transport accounts for 30-50 percent of all mobility in India. Most of these people, however, are people who are unable to own a car or a motorbike. When their income increases, these consumers also want to convert to motorized modes of transportation.

1.2 Research Gap

The world economy's unequal balance exacerbates the disadvantages of inadequate expertise and resource dependency for emerging nations (Persaud, 2001). Mobility has been dubbed the 'to' element of welfare-to-work, the engine that connects jobless, impoverished individuals from the urban core to outlying jobs (Cervero, Sandoval, & Landis, 2002). The Literature Review (Chapter 3) helps in identifying the research gap. Despite having a world-class metro system, the National Capital Region of India still lacks a seamless integration of different forms of transport alternatives that are cost-effective, reliable, and efficient. Since the region is one of the most developed in South Asia, it is imperative to have smooth connectivity across the region as it has numerous benefits like employment generation, economic growth, less traffic congestion, and a green environment among many others. For that, it is vital to identify key factors influencing the choice of transport in the region. Furthermore, the problems that were faced by the Netherlands decades ago are the same problems that the National Capital

Region of India is facing at present. Traffic congestion, high car ownership, air pollution, and fatal accidents are some examples. The available literature for the National Capital Region of India focuses on the facets that influence the choice of transport and the challenges faced by the administration and people for adopting a cycle as a mode of transportation. However, it does not focus on the key factors for cycling adoption from the viewpoint of relevant stakeholders and how these stakeholders have different priorities with regard to the adoption and development of transport networks. Furthermore, as observed in table 5, not much literature can be found on how to promote cycling in the National Capital Region of India. Moreover, the Dutch cycling practices are selected as the Netherlands is considered the best country in the world for cyclists as discuss ed in section 3.2. The Indian capital region can learn what has been done in the Netherlands and how numerous actors collaborated to increase cycling adoption.

1.3 Research Objective

The research focuses on the adoption of Dutch cycling practices in the National Capital Region of India. The significance of the research is to gather knowledge that policy-makers can use to encourage people and the government of India to embrace non-motorized modes of transportation, specifically cycling as it has many benefits. Hence, the main focus of the research will be on factors for cycling adoption, the impact of regulatory bodies in cycling adoption and the role of firms to support cycling adoption. Therefore, the main goal of the research is presented below

To bring new knowledge that policy-makers can use to encourage people and the Government of India to embrace cycling as one of the primary modes of transport by learning from the Dutch cycling practices

1.4 Research Questions

The main research question is presented below

What can the National Capital Region of India learn from the Dutch cycling practices with the participation of key stakeholders?

To address the main research question, sub-research questions are presented below

1. What are the factors for adopting a bicycle as one of the primary modes of transport in the National Capital Region of India?
2. How can the Government of India and other regulatory bodies influence the adoption of cycling in the National Capital Region of India?
3. How can firms contribute to the uptake in cycling adoption in the National Capital Region of India?

2 Methodology

The research methodology used to accomplish the research objective and answer the research questions of the thesis is described in this chapter. The objective of this chapter is to offer a clear understanding of the methodology and how the research questions and theoretical perspective are linked to finding a requisite conclusion. Section 2.1.1 provides an overview of the characteristics of the respondents, how they were recruited, and how questionnaires for the interviews were prepared. Section 2.1.2 outlines the interview protocol with the details of each interviewee. The details include the code, background, and profession of the respondents. Section 2.1.3 consists of how the interviews were analyzed and interpreted and lastly, section 2.1.4 depicts a schematic overview of the research design. Furthermore, this chapter also includes the theoretical perspective used to answer the research questions and examine the findings, that is, the Technological Innovation System (TIS) Framework (section 2.2).

2.1 Research Strategy

In order to answer the main research question and sub-research questions, this research used semi-structured interviews and existing literature. Semi-structured interviews were conducted as some essential questions were included to assist the topics to be covered, but they also give the interviewer or interviewee the freedom to go off course to delve deeper into a concept. Its adaptability, especially in comparison to structured interviews, also enables the identification of data that respondents value although the researcher might not have first deemed it relevant (Gill, Stewart, Treasure, & Chadwick, 2008).

2.1.1 Data Collection

The examination of qualitative data serves as the foundation of this research. Both primary data sources and secondary data sources are used to collect qualitative data. The major data sources were interviews, while secondary data sources included grey literature. Various media archives, including those from newspapers, journals, and internet portals, are among the sources of grey literature.

Expert interviews were conducted and the respondents were from the Netherlands and India. Interviews helped to identify the potential factors (hard and soft) that influence the choice of transport, the impact of regulatory bodies, and the role of firms in the adoption of cycling in both countries. Moreover, these interviews also helped in determining how crucial components of the Technological Innovation Systems (TIS)

framework can be incorporated into the Indian context by comparing it with the Dutch perspective.

14 semi-structured interviews were conducted which included:

- Experts in Dutch cycling to tell about the important factors, the impact of regulatory bodies, and the role of firms in the adoption of cycling in the Netherlands.
- Experts in India to tell about the important factors, the impact of regulatory bodies, and the role of firms in the adoption of cycling in India.
- Experts who have not resided in the Netherlands for longer than a couple of years so they have not forgotten what it was like to be a newcomer.

Interviewees were chosen using a method of convenience sampling due to the complexity of locating requisite participants who fit the necessary characteristics. The number of interviews that needed to be completed was calculated by the data saturation concept, which entails, the threshold where undertaking subsequent interviews generate no meaningful new discoveries (Guest, Bunce, & Johnson, 2006). A number of strategies were used to find respondents, including posting requirements for the participant in groups on social networks and prior awareness of the researcher and supervisor.

Questionnaires for the interviews were prepared in accordance with the Technological Innovation Systems (TIS) Framework (elaborated in section 2.2), the factors influencing the choice of transport, the impact of regulatory bodies and the role of firms in the adoption of cycling. Two sets of questionnaires were prepared, one for the respondents from the Netherlands and one for the respondents from India. Firstly, prepared questions were asked, and the remainder of the questions were altered depending on the answers. Emails were sent out describing the aim of the research. The respondents are not quoted and the summary of each interview is included in Appendix A. All interviews were conducted online using MS Teams.

2.1.2 Interview Protocol

All participants were asked to sign an informed consent form of participation after a brief explanation of the research's goals and the interview's format. This clarified that information will only be provided in a consolidated and anonymous form. All interviewees granted their consent in the form about the risks associated with the interview process. The interview started with the introduction of the researcher and the respondent. Afterwards, a set of questions were asked and lastly, respondents shared extra knowledge about their expertise and provided constructive feedback.

A summary has been created that contains the information of the interviewees and it is demonstrated in tables 1 and 2.

Dutch interviewees		
Code	**Background**	**Profession**
NL-1	Academic	Urban Mobility Researcher
NL-2	Professional	Mobility Expert in Cycling, Walking and Road Safety
NL-3	Professional	Filming Cyclist
NL-4	Professional	Marketing and Communications Manager at Cycling Organization
NL-5	Professional	Urban Developer
NL-6	Academic	Inclusive mobility Researcher
NL-7	Academic and Professional	Lecturer and Cycling Infrastructure Planner

Table 1: Overview of Dutch interviewees

Indian interviewees		
Code	**Background**	**Profession**
IND-1	Academic	Urbanist and Researcher
IND-2	Professional	Technical advisor-Sustainable Urban Mobility
IND-3	Professional	Project Lead-Climate Centre for Cities
IND-4	Professional	Deputy Manager-inclusive compact cities
IND-5	Professional	Urban Designer
IND-6	Professional	Senior Associate-Sustainable Transport
IND-7	Professional	Bicycle Mayor

Table 2: Overview of Indian interviewees

2.1.3 Data Analysis and Interview Interpretation

Nello-Deakin and Nikolaeva (2021) pointed out that according to a number of historical, sociological, and anthropological perspectives, it is not possible to fully comprehend the prevalence of cycling by focusing simply on hard variables like urban design and bike networks. These perspectives contend that in order to promote cycling in cities with established bike infrastructure, social conventions, and cultural backdrop have been at least as significant as urban infrastructure. Statistical research confirms this claim, showing that in established cycling areas like Copenhagen, soft variables like social conventions and cultural context are more significant for promoting cycling as compared to urban layout and planning. This aspect was also pointed out by Haustein, Koglin, Nielsen, and Svensson (2020) that both, hard and soft factors influence the public's understanding of transportation as well as their regular travel behavior, both factors help to shape the emergence of a transportation culture. Hence, both soft and hard factors will be given equal importance while analyzing qualitative data. Abdullah, Uli, and Tari (2009) described soft factors as those involving human or behavioral elements. Whereas, hard factors enable the application of soft factors and they are more system-focused (Lewis, Pun, & Lalla, 2006).

Thematic Analysis was used to analyze the interviews. A technique for finding, evaluating, and conveying patterns (themes) across data is called thematic analysis. The gathering of data is briefly organized and richly described. It typically analyzes different facets of the research problem. There are six phases of the analysis and they are described in table 3 (Braun & Clarke, 2006).

Phase	**Description of Process**
Familiarizing yourself with your data	Transcribing data (if necessary), reading and re-reading the data, noting down initial ideas
Generating initial codes	Coding interesting features of the data in a systematic fashion across the entire data set, collating data relevant to each code
Searching for themes	Collating codes into potential themes, gathering all data relevant to each potential theme
Reviewing themes	Checking if the themes work in relation to the coded extracts (Level 1) and the entire data set (Level 2), generating a thematic 'map' of the analysis
Defining and naming themes	Ongoing analysis to refine the specifics of each theme, and the overall story the analysis tells, generating clear definitions and names for each theme
Producing the report	The final opportunity for analysis. Selection of vivid, compelling extract examples, final analysis of selected extracts, relating back of the analysis to the research question and literature, producing a scholarly report of the analysis

Table 3: Phases of Thematic Analysis (Braun & Clarke, 2006)

Deductive coding is used to draw meaningful conclusions. The theoretical conclusions produced from the evaluation of the literature act as the foundation and guide the data collection in deductive coding (Pearse, 2019). This means that themes are known to the researcher prior to data analysis and this is done to make the results consistent and clear across the Dutch and Indian perspectives.

This procedure, where categories are utilized to integrate various codes acquired from raw data from interviews, is seen in the figure below.

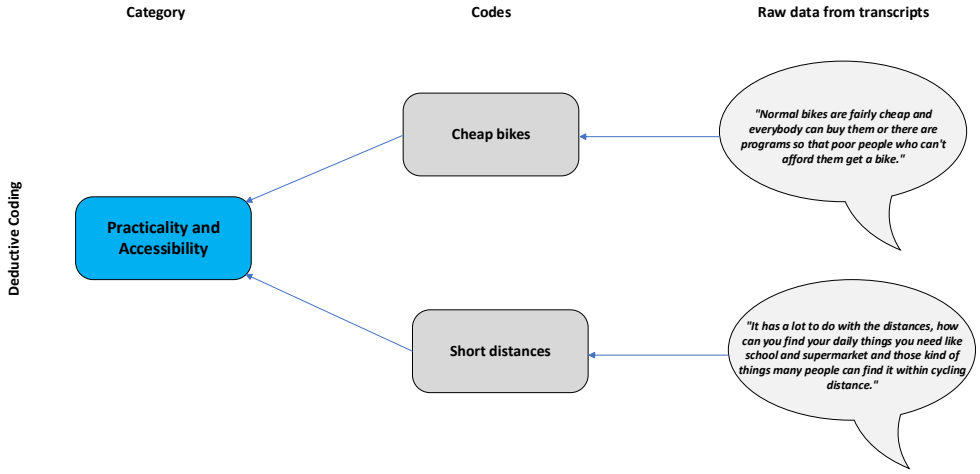

Figure 1: An example of Deductive coding

2.1.4 Research Design

A schematic overview of the research design is presented below in figure 2 to show how the research questions are answered.

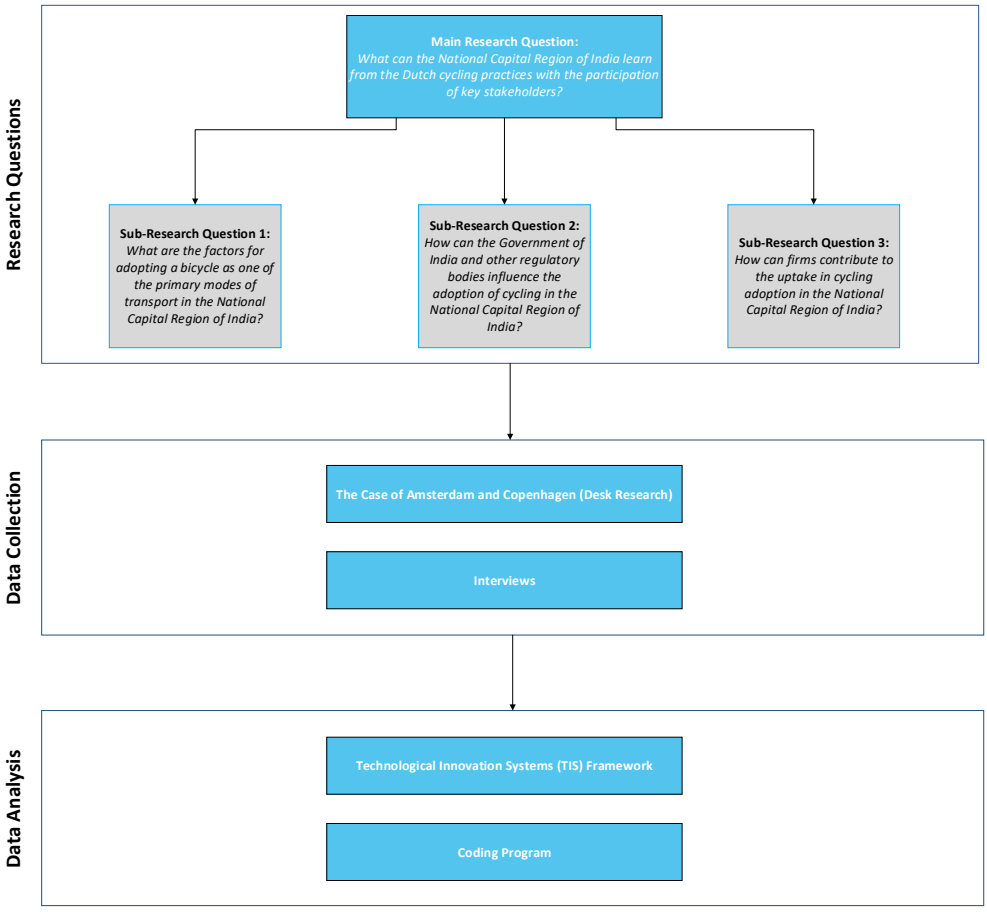

Figure 2: Schematic overview of research design

2.2 Theoretical Perspective - Technological Innovation Systems (TIS) Framework

Bening, Blum, and Schmidt (2015) explained that it is a technique to identify the numerous aspects impacting the invention and spread of specific breakthroughs. The methodology offered by the cognitive perspective to TIS has the advantage of simultaneously reducing the convolution of innovation changes and offering a systematic perspective on it. TIS provides a systematic way of dealing with innovations, detects structural flaws in them, and proposes structural dimensions (multiple stakeholders) to deal with the diffusion of technology (Bening et al., 2015; Wieczorek & Hekkert, 2012). According to Bergek, Jacobsson, Carlsson, Lindmark, and Rickne (2008), sociotechnical frameworks were centered on the creation, spread, and application of a certain technology. TIS includes not just elements specifically devoted to the technology under consideration, but also any elements that have an impact on how that innovation is developed. A TIS might span many domains or be a branch of a sectoral network.

Along with the interviews and The Case of Amsterdam and Copenhagen (Chapter 4), the Technological Innovation Systems (TIS) Framework is used to answer the research questions and analyze the findings. The gaps in the Indian context and what the Dutch context comprises with regard to cycling are also identified. In the Findings (Chapter 5), the TIS framework is discussed in relation to the information gathered from the interviews.

2.2.1 Analysis

Bergek et al. (2008) highlighted different stages in TIS, however, for this study, only the structural dimensions and functions are discussed as they are suitable to answer the research questions.

Classification of Structural Dimensions

According to Wieczorek and Hekkert (2012), there are four structural components of TIS and they are as follows:

1. **Actors:** The evidence is unanimous that actors have a contribution to innovation activities. In order to analyze TIS, we divide actors according to how they participate in economic activity: social groups, government, non-governmental organizations, multinationals, educational institutes, and other parties like ju-

dicial organizations, economic organizations, and intergovernmental organizations. These many actors can act in various capacities.

2. **Institutions:** Institutions are a collection of similar practices, procedures, and notions utilized by people in recurring circumstances (soft institutions) that are structured by regulations, norms, and strategies (hard institutions). Institutions vary from enterprises in that their organizational structures and capabilities are based on their geographic and intercultural distinctiveness.

3. **Interactions:** Since interaction is variable, it is challenging to think of it as a structural component. The term **network** is frequently utilized in studies to refers to the connections and interactions among actors. Interactions can happen outside of networks as well. There aren't any networks in the early phases of a system's creation, although interpersonal exchanges among actors can be observed.

4. **Infrastructure:** There is no clear consensus among the major perspectives in academia regarding what the term infrastructure refers to, and infrastructure lacks a stable place as a structural component of innovation systems. The phrase infrastructure refers to the accessibility of resources for development through funds, subsidies, or programs. The significance of the physical and intellectual infrastructure is underlined and has a significant part in determining the supremacy and dynamics of technologies.

Modeling the Functional Mechanism

Bergek et al. (2008) argued that defining the TIS's functional layout constitutes an important stage in a functional TIS study. It tries to determine the degree to which the functions in that TIS are now filled, that is, to examine how the TIS is acting in terms of a number of significant procedures. Hekkert, Suurs, Negro, Kuhlmann, and Smits (2007) proposed seven TIS functions that are elaborated on below.

- **Function 1 - Entrepreneurial activities:** An innovation system cannot exist in the absence of entrepreneurs. They are necessary for innovation to work effectively. In order to create and seize new business possibilities, entrepreneurs must transform the potential of novel information and partnerships into actionable steps. To deal with the precariousness that results from novel pairings of information and industries, entrepreneurs must engage in experimentation that can broaden their horizons. Furthermore, responses from the public, government, rival businesses, and vendors can be assessed. It is anticipated that a company's chances of constructively generating an innovation will largely rely on the way

the innovation system is built with regard to functions 2 to 7 and a structure that works well will likely provide an environment where new ventures flourish.

- **Function 2 - Knowledge development:** All innovation procedure revolves around learning processes. The information serves as one of the essential resources for development, making learning a crucial activity. Research and Development and knowledge creation are thus necessary components. Some markers are used to elaborate on the function with regard to time and they are projects, patents, and investments. It is also possible to use learning curves to monitor the overall effect.

- **Function 3 - Knowledge diffusion:** The transfer of knowledge is networks' primary purpose. This is significant in a rigid R&D environment, though it's crucial in a complex one where R&D interacts with the authorities and rivals. Here, policy proposals need to be in line with the most recent technical advancements, while R&D programs must also take evolving principles into consideration. This makes network engagement a necessary prerequisite for learning through interaction.

- **Function 4 - Guidance of the search:** Since there are several technology possibilities available, it is crucial that certain priorities are selected for ongoing developments because resources are usually restricted. This role may be carried out by a number of system elements, including business or administration. This function illustrates the selection process and denotes those initiatives inside the innovation process that may have a beneficial impact on the transparency and awareness of certain user needs.

- **Function 5 - Market formation:** In many cases, novel innovation struggles to contend with integrated innovation. Numerous discoveries are still rather primitive and ineffective when they are initially acknowledged as new innovations. As they are fundamentally ill-suited to a number of the final purposes of the application, they might only provide very slight improvements over currently used methods. In these conditions, dispersion will inevitably be sluggish and hence, it is vital to provide safe spaces for new technology.

- **Function 6 - Mobilization of resources:** All operations inside the innovation process require resources as a fundamental necessity. The provision of enough resources is required for a particular technology in order to enable knowledge creation. A typical instance of this sort of action includes funding provided for research and development projects established by businesses or governments to advance specialized technical expertise and funding provided to enable the evaluation of novel innovations in specialized studies.

- **Function 7 - Creation of legitimacy:** A novel technology must merge with a current policy. The power of creative destruction is frequently opposed by those with preexisting agendas. In that situation, advocacy coalitions can act as a driver by putting a new innovation on the table, advocating for funding and advantageous tax policies, and therefore giving the new technical path legitimacy.

3 Literature Review

The chapter starts with the literature search process (section 3.1). The objective of this chapter is to gain a good understanding of cycling in the Netherlands (section 3.2) and the National Capital Region of India (section 3.3) and identify the research gap. Section 3.4 discusses how the literature review helped in identifying the research gap and summarizes the factors for cycling adoption from the outlook of multiple stakeholders.

3.1 Literature Search Process

The analysis of the literature is explained in this section. Google Scholar and Elsevier Scopus were used as academic search engines to find the requisite literature. The keywords and synonyms were found in the context of the research questions. To increase the number of probable research-related articles, combinations of synonyms were employed. The keywords are presented in table 4. Firstly, the search for literature focused on finding the literature related to cycling in the Netherlands. It involved the government's role in cycling adoption, the consequences on the local population of cycling adoption, and the share of journeys done by cycling among other aspects. Secondly, it focused on finding the literature related to cycling in India. It involved the current scenario, challenges to cycling adoption, cycling integration with other modes of transportation, and social perspective regarding cycling in the National Capital Region of India.

Keywords
Cycling, Biking
Netherlands, Dutch
India, National Capital Region of India, NCR
Adoption, Uptake
Firms, Organizations
Infrastructure, Safety
Governance, Administration, Policy
Mobility, Transportation
Barriers

Table 4: Keywords for literature search

Table 5 provides an overview of the publications used to determine the research gap which is elaborated in section 1.2.

S No.	Author(s)	Publication Title
1	Machavarapu and Ram (2022b)	Review on public bike share schemes in large developing cities: a case study of Delhi, India
2	Pucher, Peng, Mittal, Zhu, and Korattyswaroopam (2007)	Urban Transport Trends and Policies in China and India
3	Ravensbergen (2022)	Examining the gendered and classed embodied experiences of cycling
4	Gupta (2017)	Role of Non-Motorized Transport in Distribution of Goods in the Metropolitan City of Delhi
5	Murthy and Sur (2023)	Cycling as work: mobility and informality in Indian cities
6	Singh (2005)	Review of Urban Transportation in India
7	Tiwari (2003)	Transport and land-use policies in Delhi
8	Mohanty, Bansal, and Bairwa (2017)	Effect of integration of bicyclists and pedestrians with transit in New Delhi
9	Handy, Van Wee, and Kroesen (2014)	Promoting cycling for transport: research needs and challenges
10	Das and Parikh (2004)	Transport scenarios in two metropolitan cities in India: Delhi and Mumbai
11	Tiwari, Jain, and Rao (2016)	Impact of public transport and non-motorized transport infrastructure on travel mode shares, energy, emissions and safety: Case of Indian cities
12	Patel and Patel (2020)	A stakeholders perspective on improving barriers in implementation of public bicycle sharing system (PBSS)
13	Joshi and Joseph (2015)	Invisible cyclists and disappearing cycles: the challenges of cycling policies in Indian cities
14	Rahul and Verma (2013)	Economic impact of non-motorized transportation in Indian cities
15	Pucher, Korattyswaroopam, and Ittyerah (2004)	The crisis of public transport in India: overwhelming needs but limited resources
16	Tiwari (2002)	Urban Transport Priorities: Meeting the Challenge of Socio-economic Diversity in Cities, a Case Study of Delhi, India

Table 5: Overview of the publications used to identify the research gap

3.2 Cycling in The Netherlands

3.2.1 Role of the Government

Several governments promote bikes for traveling due to their advantages. Authorities frequently use methodologies from other countries as a starting point when creating their domestic guidelines for encouraging cycling (Heinen & Handy, 2012). In the Netherlands, politicians support cycling because it is advantageous in numerous aspects. By developing an appropriate network, the administration has worked hard to improve riding opportunities. Additionally, financial assistance is provided to promote cycling (Oakil, Ettema, Arentze, & Timmermans, 2016). The government promotes biking by providing tax incentives to employees over their employers, allowing them to purchase a bicycle without the need to pay any taxes once in three years up to a certain price (Heinen, Maat, & Van Wee, 2013).

Due to state-of-the-art biking infrastructure and network, the number of deaths has decreased by 67% in the last four decades. Furthermore, cycling paths of approximately 30,000 kilometers have been built which is an increase of more than 20,000 Kilometers from the 1970s (Wardlaw, 2014). Cycling helps to avoid more than 6000 fatalities annually and it also gives residents of the Netherlands a higher span of life. The value of such health advantages is greater than 3% of the entire GDP (Fishman, Schepers, & Kamphuis, 2015). Cycle-friendly policies and well-developed infrastructure result in wider adoption and less reluctance from local people to select cycle as their preferred mode of transportation. The discussion of fewer bike accidents in the Netherlands is also shown in figure 3 below and it can be seen that the Netherlands has the least number of fatalities by a cycle followed by Denmark and Sweden (Pucher & Buehler, 2008a).

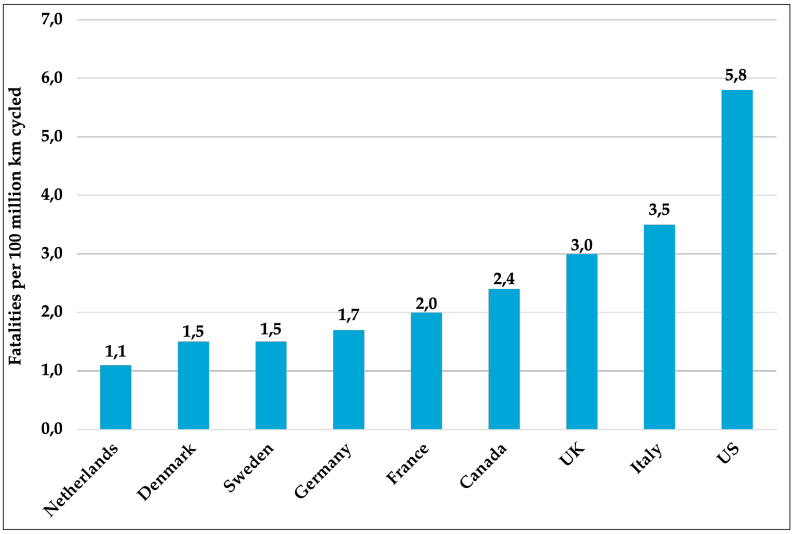

Figure 3: Rate of cycling deaths (Pucher & Buehler, 2008a)

3.2.2 Impact on Local Population

As noted by Rietveld and Daniel (2004), bicycles are used for about a quarter of daily journeys done by each individual. This proportion rises to one-third when journeys under 7.5 km are taken into account and to just less than half when journeys within 2.5 km are considered. High adoption may be attributed to The Netherlands' flat terrain, with a 1/3 of its total area under sea level. The findings of the study conducted by Rietveld and Daniel (2004) suggest that cycle adoption can soar by raising the cost of alternatives and devising one form of mobility highly appealing by minimizing its expenses.

Figure 4 shows the proportion of journeys made by bicycle in numerous countries (Pucher & Buehler, 2008a).

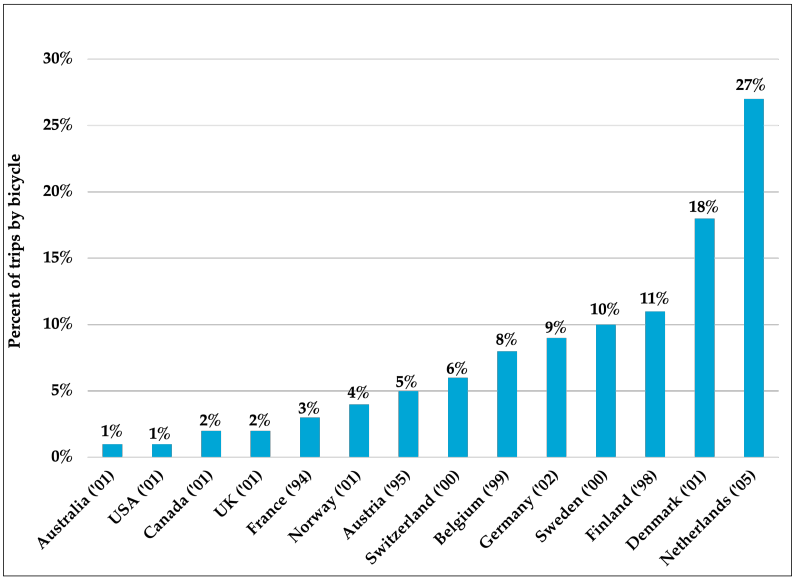

Figure 4: Proportion of bicycle journeys (Pucher & Buehler, 2008a)

A survey was conducted by Heinen et al. (2013) on the influences of the workplace on the decision of commuting type which included more than 4000 respondents from multiple municipalities. The findings show that aspects like the presence and accessibility to secure bicycle parking, coworkers' anticipation to bike for the job, and the option for getting dressed in workwear are among the requisite elements for people to cycle to work. Whereas, facets, like paid public transit tickets, longer travel time, and requirements to move products, have detrimental impacts on the need to bike at workplaces (Heinen et al., 2013).

Social inequality emphasizes that inferiority is the outcome of a procedure that precludes some individuals from participating in activities deemed usual in the commu-

nity, as opposed to unchanging explanations of hardship that stress on physical well-being (Van der Kloof, Bastiaanssen, & Martens, 2014). Related to this argument, another crucial point discussed by Martens (2013) is the bicycle's contribution to reducing commuter distress and hardships. The Dutch National Travel Survey highlights a few categories of people that ride bikes more than others like homes without automobiles, women, and low-income communities. People without cars use bicycles for 41% of their journeys, compared to vehicle users, who use them for a mere 15%. These national statistics highlight the significance of cycling for the majority of populations at risk of transportation difficulties (Martens, 2013).

3.3 Cycling in the National Capital Region of India

3.3.1 Introduction

Accelerated population increase and industrialization are major issues in emerging nations like India, leading to a number of transportation concerns including road jams and deaths, smog, and environmental degradation (Machavarapu & Ram, 2022b). Due to the lengthened commutes of the majority of city dwellers, there is now a higher requirement for mobility, which increases congestion on the roads. Additionally, longer journey duration ends up making biking and walking less practical, which promotes the use of powered alternatives rather than non-motorized ones (Pucher et al., 2007). India's automobile population has approximately quadrupled from the last decade of the 20th century, which has resulted in significant rises in road fatalities, smog, congested roads, and power consumption. If emerging economies including India and China proceed along the course of accelerated automation, the minor savings in environmental pollution, climate change, and power consumption will be greatly outweighed by the rising impacts of these problems (Pucher et al., 2007). Scholars, decision-makers, and officials have started to challenge the wisdom of designing neighborhoods for personal cars in the face of mounting ecological, socioeconomic, and medical issues. As an alternative, several communities are now supporting more environmentally friendly transport options including cycling (Ravensbergen, 2022).

Delhi has a distinctive identity. It serves as a center for the area around it as well as a developing place of interest for individuals from every corner of the nation. Delhi is 1483 square kilometers in size and has 16.75 million people as of 2011, up from 13.85 million a decade ago. The density of the population was 9340 per square kilometer in 2001 which increased to 11,300 by 2011. Furthermore, in 2011, there were approximately 7.5 million registered vehicles, cars consisting of one-third of the total, and the remaining were vehicles with two wheels (Gupta, 2017). Delhi has favored projects

that promote large-scale infrastructure above more modest neighborhood-focused initiatives that will reacquaint locals with low-carbon forms of transportation. This has been corroborated in a study by UN-Habitat that acknowledges the factors that are driving an automobile-focused narrative (Murthy & Sur, 2023). It is vital for residents to cycle and the authorities must promote initiatives that make cycling an attractive mode of transport in the city (Singh, 2005). In Old Delhi, which has twisting, narrow roads and, sluggish traffic, cycle is a common form of transportation for both individuals and their possessions. Cycles are affordable transportation options that not solely allow for economic transport but also support, develop and maintain crucial economies (Murthy & Sur, 2023). Urban mobility is an intricate system that is governed by transport and land-use regulations. Yet, just a few factors are frequently measured and examined in cities where sophistication levels rise as a result of significant differences amongst people who live there (Tiwari, 2003).

Murthy and Sur (2023) pointed out that cycles are still neglected by the administration as obstructions to motor traffic. They are seen as annoyances that clog roadways. Cycling to the workplace is not simply a means of transportation for city inhabitants who carry products and commodities; it is a requirement for a living and labor that supports cities. In spite of growing restrictions on cycling, it supports families and propels industries (Murthy & Sur, 2023). Improved transit connectivity simplifies the process for cyclists to use transportation to extend their trips, and get around obstacles easily making it an attractive form of mobility (Mohanty et al., 2017). Handy et al. (2014) emphasizes two major obstacles that cities confront to boost biking for mobility and they are, figuring out how to use the scarce assets, and establishing the case for setting aside a larger portion of scarce assets that are earmarked for biking.

The per capita income in Delhi grew two times in the period between 1997 to 2020 and the proportion of cars and two-wheelers increased at an equivalent pace as shown in table 6. The table below depicts the proportion o vehicles per 1000 persons in Delhi (Das & Parikh, 2004). This table depicts the rapid growth of motorized vehicles in Delhi.

Year	**Car**	**Two wheeler**	**Three wheeler**	**Taxi**	**Bus**
1997	58	133	5	1	1.4
2005	69	134	4	0.6	1.2
2010	72	174	7	0.8	1.5
2015	85	209	8	0.9	1.4
2020	111	263	9	1	1.8

Table 6: Vehicles per 1000 persons in Delhi (Das & Parikh, 2004)

3.3.2 The Present Situation and Challenges

The usage of non-motorized transport has been steadily declining. The poorly maintained network puts riders at a serious hazard of inconvenience and road mishaps. Mostly, cities in India are making investments to guarantee quick traffic flows, including plans for motorway enlargement and the construction of overpasses (Tiwari et al., 2016). India's percentage of transportation by bicycle has steadily fallen, from 35% in 1980 to 13% in the last decade (Patel & Patel, 2020). Indian urban planning has failed to acknowledge the more extensive utilization of streets as rightful and an essential component of the metropolitan lifestyle, sidewalks intended for a range of purposes, such as walking, selling, and bonding have been reduced to being used only by automobiles (Joshi & Joseph, 2015). Advanced enforcement procedures for traffic regulation are absent in most of the cities in India and it is not necessary for strollers, bikers, and trolley lifters because they are not regarded as traffic. The concept of road capacity is deeply ingrained in the minds of police officers, who identify with automobiles and recognize other actions as obstructions to their smooth movement (Joshi & Joseph, 2015). Also, non-motorized means are largely left off the transit reform priorities due to a dearth of clarity on their financial consequences (Rahul & Verma, 2013).

It is sometimes forgotten that aspects, including familial characteristics with regard to the area of residence, occupational prestige, etc. affect how reform initiatives function. Facets like land management, connectivity, and affordability are vital for the wide adoption of cycling across the country Oakil et al. (2016). A significant proportion of middle-class people and the prevalence of small journeys in Indian cities are the two key reasons that may be credited in support of the expansion of transportation modes like cycling and walking (Rahul & Verma, 2013). Polls concerning travel behavior were done in a number of metropolitan areas, however, they are not always equivalent because they were done separately by various businesses employing various techniques. Furthermore, the polls that are now accessible are not generalizable because they concentrate only on metropolitan areas (Pucher et al., 2007).

India's projected 61% rise in emissions during the last decade of the 20th century indicates an environmental issue. Establishing emission limits may be envisioned to result in a lower direction in air contamination, but the vastly increased use of automobiles would render such effort ineffective (Rahul & Verma, 2013). The positive effects of exercise on population health outweigh the negative effects of cycling. With little proof for bicycle processes, hazards from polluted air can indeed be presumed to be low. Cycling has been a minor consideration in mobility and healthcare strategies. The apparent hazards of accidents and poor air quality associated with cycling, different socio-cognitive obstacles and an absence of emphasis on strategy and decision

making may all contribute to this (Götschi, Garrard, & Giles-Corti, 2016). Rahul and Verma (2013) emphasized that cycles are incorporated into the lifestyle of nations like the Netherlands and are not seen as a mode of transportation used by indigent people. The way to change social views in Indian society is to promote strolling and bicycling as viable, ecologically responsible transportation options using education campaigns. It is fundamental for the administration to have the will to promote non-motorized forms of mobility and spread awareness about the merits of the same.

3.3.3 Integration of Cycling with Public Transport

Transport networks make up one of several variables determining the life quality in a place. Many Indian cities are experiencing worsening urban transportation conditions. In large cities with an overwhelming number of automobiles, the degradation is particularly noticeable. In such places, commuters contend with severe traffic jams, worsening pollution, and risks of accidents. A clear plan is required to tackle such issues and increase the efficiency of the city's transportation networks while also promoting green forms of mobility (Singh, 2005). The transport networks in India are under tremendous burden due to the country's explosive urbanization. The finite amount of services and facilities for transportation cannot keep up with the ever-increasing need for transportation. Notably, public transportation has been inundated and the majority of it is crammed, unreliable, sluggish, chaotic, and hazardous (Pucher et al., 2004).

Mohanty et al. (2017) pointed out numerous issues in the public transportation system of India. The first significant difficulty is monetary. India has been compelled to maintain its public transportation rates exceptionally cheap due to the country's GDP per capita. This has resulted in lower earnings, having a negative impact on service, modernization, and growth. As a result, integrating public transportation with non-motorized alternatives such as bicycle is a less expensive option for expanding it (Mohanty et al., 2017). Secondly, population increase has resulted in high mobility requirements. The growing need for transportation has outpaced the rise of public transit. The last two decades have seen the percentage of motorized vehicles growing and a decrease in the percentage of people opting for public transport. Roads are now extremely congested and air quality is at an all-time low resulting in harmful consequences (Mohanty et al., 2017).

3.3.4 Socio-economic Perspective

For a large portion of the Indian population, riding a motorbike is an economical, accessible, handy, quick, and reliable alternative to using public transportation. The private vehicle provides far more luxury and status for rich Indians, yet it is prone to be impeded by traffic as compared to motorbikes (Pucher et al., 2004). The amount of money poor families spend on transportation affects their ability to meet basic requirements like food, home, and health. Due to the lack of additional social networks, people frequently abandon their interim employment in order to travel to the hospital to see their loved ones. This makes them more susceptible to incidents like road accidents. The monetary and psychological effects of such events can be catastrophic and may financially ruin the household (Tiwari, 2002).

(Murthy & Sur, 2023) pointed out that an event was planned in Delhi which was intended to inspire locals to adopt cycling, but, it was extremely challenging to get participants among the middle-class residents. Most of them claimed that they don't have a cycle and in spite of providing cycles at no cost, the majority rejected them. Middle-class citizens are entangled in a loop that promotes the proliferation of vehicles and demotivates cycling in their day-to-day lives. Middle-class communities frequently forbid pedal two-wheeler from accessing their residential areas, alleging instances of unwelcome anti-social behavior and harm to cars that are parked (Murthy & Sur, 2023).

3.4 Conclusion

It can be observed in the literature review that not much literature is available on how to promote cycling in the National Capital Region of India. The available literature only discusses the challenges to cycling adoption, the current situation of traffic, and the modal integration of transportation. The socio-economic perspective of the Indian context helped in understanding what is the general notion of people with regard to their choice of transportation. Therefore, the literature review helped in identifying the research gap which is elucidated in section 1.2.

The literature review also presents the factors for cycling adoption and in the case of the Netherlands, they are good infrastructure which is safe and results in fewer accidents, ample availability of bike parking, and social inclusiveness. These factors are influenced by the government as they provide financial support and create cycle-friendly rules and regulations. The firms in the Netherlands influence these factors by offering sufficient parking spaces at workplaces and providing changing facilities in the office for employees.

4 The Case of Amsterdam and Copenhagen

The purpose of this chapter is to gain a deeper understanding of cycling in Amsterdam and Copenhagen. This chapter discusses how these cities became the most advanced to cycle in, what is the current situation and the satisfaction level of cyclists. This chapter helped to relate the findings from the interviews and is also presented to help the reader understand how cities have changed to become cycle-friendly. Lastly, a conclusion is presented by relating the findings from this chapter with the structural dimensions and functions of the Technological Innovation Systems (TIS) Framework.

4.1 Introduction

Cycling has the ability to make urban areas increasingly desirable to reside in while simultaneously enhancing the urban transportation network. An important priority for decision makers throughout the globe is to increase cycling patterns as cities strive to improve livability, well being, and tackle rising temperatures with limited resources (Nello-Deakin & Nikolaeva, 2021). For years, Amsterdam has steadily enhanced the cycling environment, and as a consequence, it has evolved into one of Europe's most environmentally friendly capitals, providing easy-to-use, secure, and socially desirable substitutes to reliance on automobiles. In contrast to North American cities, all facets of the population cycle in the Netherlands, including all age brackets, economic levels, and females just as frequently as males (Buehler & Pucher, 2009). It was pointed out by Kuipers (2013) that cycling is a vital characteristic of the Dutch national habitus. Authorities or businesses do not impose a biking culture. Essentially due to the way one travels from point to point, bicycles are used by the vast majority of individuals in the Netherlands. The bicycle is a common mode of mobility in the Netherlands, not only for students, athletes, or those who value the environment but for everybody, including the working class, bureaucrats, as well as the Royal Family.

The Danish capital of Copenhagen could provide valuable insights as the city is developing with an aim to become the world's finest city for cycling (Gössling, 2013). Children's everyday events, which include transportation to schools involve cycles. Furthermore, cycling is accepted in mainstream society across all groups, a working professional and a member of parliament, a student and a mechanic, cycle to work or ride a bicycle for leisure. Biking is not viewed as an indicator that one can't purchase an automobile (Jensen, 2013). Nielsen et al. (2013) highlighted that the city of Copenhagen offers an excellent cycling environment in regard to convenience and quality that includes a sizable system of cycle routes and lanes, dedicated bike signals at crossings, and more. On average, a Dane cycle 530 Km in a year which is lower than what

people do in the Netherlands, which is 850 Km. The majority of cycling in Denmark has traditionally been referred to as utility cycling, which is focused more on getting people from one place to another than on recreation (Nielsen et al., 2013).

4.2 Cycling Capitals of the World

4.2.1 History of Amsterdam

Bolhack, Bouchard, Duckworth, Goddard, and Sams (2013) pointed out that cycling's prominence started growing in the 1970s after a phase that was focused on automobiles. Cycling was a popular mode of travel prior to World War II, but the city's post-war reconstruction program, which emphasized building more roads, was based on the city's loss of bike lanes. The following years saw a continuation of this growth, which all but eliminated biking in Amsterdam.

Unfortunately, as the number of cars increased, so did the number of fatal accidents. Upwards of 3,000 individuals died in fatal accidents in 1971, with 450 of them being children. The Stop de Kindermoord campaign picked up steam and supported a priority for enhancing bike infrastructure rather than automotive infrastructure. The 1973 Middle East oil turmoil also aided in hastening the change. These changes prompted an infrastructure upgrade that increased the number of bike lanes and decreased the number of roads (Bolhack et al., 2013).

4.2.2 The Status Quo in Amsterdam and Copenhagen

Cycles are responsible for forming an image of Amsterdam across the world as the cycling hub of Europe. In the city center, bicycle journeys made up 55% of vehicle journeys at the start of the 21st century. Over one-third of vehicle journeys in 2008 were made by cyclists and this proportion is unparalleled when compared to other European cities with similar population and area (Buehler & Pucher, 2009). By 2017, cycling accounted for 35% of all journeys, which makes it the most prevalent mode of mobility as compared to personal vehicles (25%), walking (23%) and public transportation accounted for 16% (Nello-Deakin & Nikolaeva, 2021). Biking in Amsterdam is made possible by its terrain as the majority of the city is lowland and heavily populated. Travel times are kept to a minimum and cycling through the downtown area is made simple by the abundance of bike crossings and lanes. In contrast, driving in the center of Amsterdam is challenging as car traffic is hampered by a lack of parking spots and one-way roads (Buehler & Pucher, 2009).

Due to the prevalence of infants riding in seats on bakfiets or cargo cycles, children in Amsterdam are now exposed to bicycles from a very early age. Moreover, bike classes are a required component of the Dutch education system. Throughout the city, there are presently more bicycles than people and that rate is 1.5 bikes per person (Bolhack et al., 2013). Buehler and Pucher (2009) emphasized that the core of Amsterdam's transportation strategy is non-motorized means of transportation. Without further steps to enhance safety on roads, around 40 million euros in public funding was spent on bicycle initiatives between 2007 and 2010. The overall amount to support cycling rose to 70 million euros across 4 years with matching contributions from several government bodies. This works out to roughly 13 euros per resident annually, which is similar to other bicycle cities in the Netherlands.

Nielsen et al. (2013) pointed out that the national cycling patterns in Denmark are not similar to Copenhagen. There was a well-known decrease in riding from the last decade of the previous century to a steady rate at the end of the 2000s. However, the outlook is different in the capital, Copenhagen. As seen in figure 5, cycling has been increasing at a decent rate.

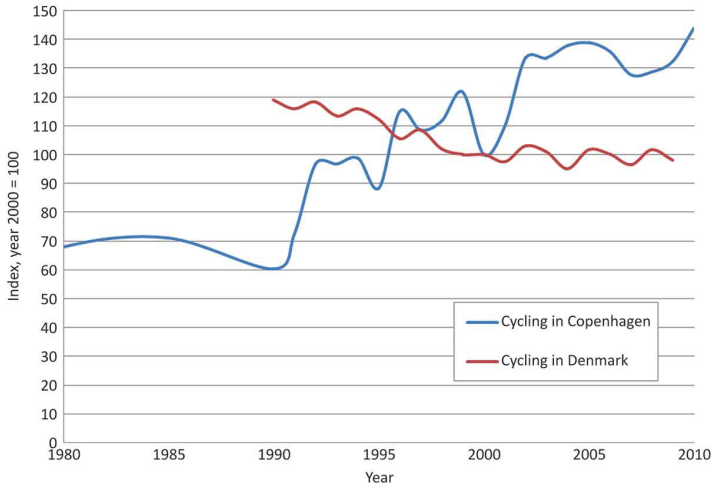

Figure 5: Comparison of cycling patterns in Denmark and Copenhagen (Nielsen et al., 2013)

In examining the performance of cycling in Copenhagen, three major classifications are used, namely, 1. Fiscal tools like taxes and subsidies. 2. Control tactics like limiting the use of the motorized mode of mobility and developing appropriate infrastructure. 3. Soft initiatives like public involvement and awareness (Nilsson, 2019). The research was conducted to assess urban transportation systems. It was found that urban transportation culture was impacted by numerous factors. They are administration choices and management, traditional landscape, lifestyle, and interaction. This research con-

cluded that transformation in mobility culture depends on infrastructure, laws, and planning. It also points out that socio-cultural elements must be explored extensively in order to bring change at a larger scale (Nilsson, 2019).

4.2.3 Satisfaction of Cyclists in Amsterdam and Copenhagen

Amsterdam Bike City (2021) carried out a study involving over 1700 cyclists that offers insight into cycling satisfaction. Participants were tasked with assessing the efficiency, comfort, convenience, safety, and appeal of their bicycle trip. The findings indicated that the appeal of the cycling trip accounts for almost one-third of the satisfaction level and comfort accounted for 26%. Thus, the quantity and quality of the infrastructure, the variety of the journey, the pollution levels and the degree of disturbance by noise, all have a significant impact on how enjoyable cycling is. Figure 6 represents the Cycling Satisfaction Monitor as formulated by the Municipality of Amsterdam.

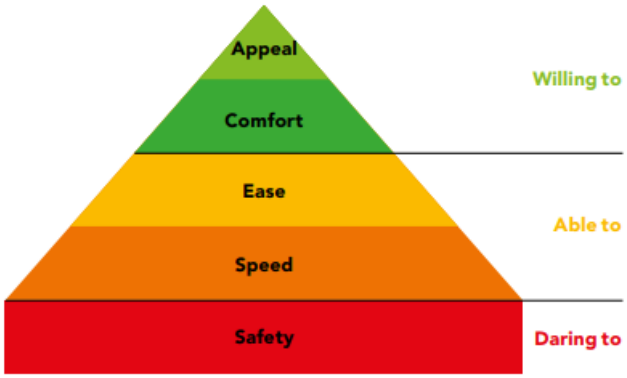

Figure 6: Cycling Satisfaction Monitor (Amsterdam Bike City, 2021)

There are additional factors besides high-quality roads and other infrastructure that affect the cycling journey for people. A variety of elements, such as interacting with other people, the buzz surrounding eateries, or the breeze, have a cumulative effect. These factors must be considered in the course of optimizing the cycling journey (Amsterdam Bike City, 2021).

Since 1996, satisfaction with Copenhagen as a bike metropolitan area has steadily improved, and it presently boasts a 94% acceptance rating. As seen in figure 7, satisfaction is low in some areas, primarily due to an increase in the number of bicyclists. In addition, the city surveys bikers on potential changes. Safety is a widespread concern, with 67% of bikers feeling safe on roads during rush hours. Just over half of bikers who claim to feel uncomfortable blame it on automobiles (Gössling, 2013).

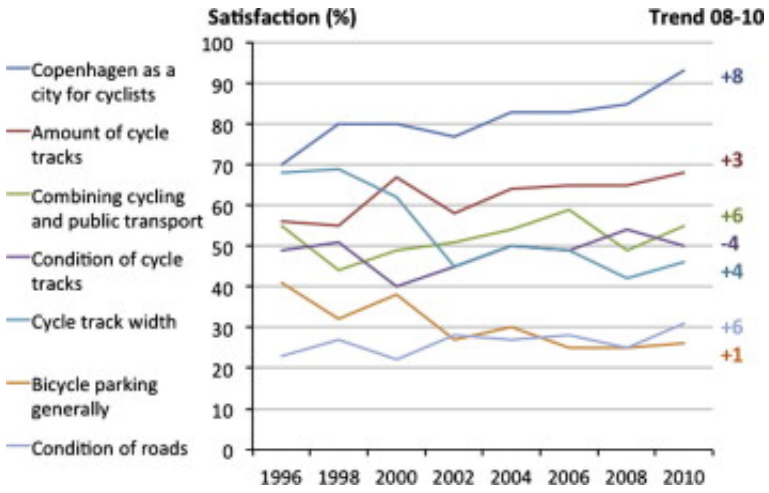

Figure 7: Satisfaction of cyclists (Gössling, 2013)

4.3 Conclusion

Amsterdam is considered the cycling capital of the world for numerous reasons. State-of-the-art cycling infrastructure, rules and regulations, and government policies are some reasons for it. Importantly, as emphasized in section 2.1.3 by Haustein, Koglin, et al. (2020) and Nello-Deakin and Nikolaeva (2021), along with the hard factors mentioned above, soft factors are also equally relevant for uptake in cycling adoption. Social acceptance, cultural background, and people interaction are some examples of such factors. Cycling rates are second to none in Copenhagen and the infrastructure is one of the best. This shows the will of the government and people to adopt cycling as the primary mode of transport in daily life. The case of Copenhagen highlights that soft factors like lifestyle and interaction are important to embrace cycling culture. Socio-cultural factors like public acceptance and general awareness also play a vital role in cycling adoption. Importantly, as seen in figure 5, Copenhagen is way ahead in cycling as compared to the rest of Denmark. This is significant for the research as the area of focus is the National Capital Region of India and not the entire country. It emphasizes that a region or a city can adopt cycling practices irrespective of what other places in that same country choose to do. The municipality of Copenhagen pointed out that a city that encourages bicycling has more green space, less noise, better air quality, happier residents, and a stronger economy (Larsen, 2017).

Regarding the functions and structural dimensions of the Technological Innovation Systems (TIS) Framework (section 2.2.1), the interaction of functions with the structural dimensions and the presence of all functions is observed in both cities. It is observed that high cycling rates enable *Interactions* between different *Actors* and this results in the development of *Infrastructure*. One such example is that the administra-

tion *(Actor)* has made it difficult to drive a car in the city centre of Amsterdam to promote cycling and make it safer *(Institutions)*. This suggests that *Creation of Legitimacy* and *Guidance of the Search* functions are present. Moreover, cycling lessons are given importance in the education system of the Netherlands, and this results in *Knowledge Development* and *Knowledge Diffusion*. In the case of Copenhagen, *Mobilization of Resources* function is present as the government *(Actor)* incentivizes cycling by providing subsidies and tax benefits *(Infrastructure)*. These measures lead to *Market Formation* and *Entrepreneurial Activities* as more people *(Actor)* are encouraged to cycle. Hence, it can be observed that functions and structural dimensions of TIS are imperative in the adoption of technology and to understand how to increase the adoption by analyzing the same.

5 Findings

This chapter includes the findings from the interviews. Also, a discussion is presented in sections 5.1.3, 5.2.3 and 5.3.3 that relate the Technological Innovation Systems (TIS) Framework to the findings from the interviews. This segregation is done to make it clear to the reader the findings from the interviews and how it is related to the existing literature (Chapter 3) and The Case of Amsterdam and Copenhagen (Chapter 4). Furthermore, factors related to the Dutch perspective are highlighted in orange, and factors related to the Indian perspective are highlighted in blue to make the findings visually clear and easy to read.

5.1 Factors Affecting Cycling Adoption

5.1.1 The Dutch Perspective

Numerous key factors, hard and soft, were discovered that promote cycling across the Netherlands through the examination of the information gathered from interviews. The meaning of hard and soft factors and the reason to analyze both of them is discussed in section 2.1.3. The factors elucidated below are not in any specific order and certain convergence among factors might be present due to the nature of the study and the information provided by the respondents.

Hard Factors

Infrastructure

In order to enhance cycling and promote it, it is crucial to develop top-quality infrastructure as numerous studies in the past have concluded the same. Many studies have demonstrated the significance of bicycle infrastructure. Research has shown the beneficial effects of bike lanes on the degree of bicycling engagement, suggesting that putting in place cycling infrastructure can motivate greater numbers of individuals to cycle (Hong, McArthur, & Stewart, 2020). Chapter 4 also elaborates on how Amsterdam and Copenhagen became the best cities for cycling in the world.

Moving on to the results of the interviews, multiple respondents (NL-2, NL-4, NL-7) pointed out that urban planners in the Netherlands have always worked to design a city as a network of grids of origins and destinations that not only connects homes to workplaces but also to shops, restaurants, community centers, schools, and so on. This was also one of the key findings from Chapter 4 (section 4.3) as it has also resulted

in an inclusive environment for all types of people. Furthermore, it was emphasized by respondents (NL-1, NL-4, NL-5) that there is appropriate cycling parking in most of the cities, especially near the train stations. The city of Amsterdam has recently opened underwater bike parking which is connected to the central station of Amsterdam. The synergy between public transport, cycling, and infrastructural support is what makes cycling desirable (NL-7). An interviewee (NL-2) mentioned that it is a challenge to build a good cycling network around a country or city as it is not as easy as building a highway for cars. It is a requirement to build every street in the city cycle-friendly which is mostly done in small phases. A step-by-step approach is often adopted to build a mesh of good cycling routes on the busier streets that diverges into smaller neighborhoods. Moreover, (NL-4) mentioned that the Dutch are never satisfied with what they have and this is the reason why the cycling infrastructure keeps on improving. There is also an approach that is defined by five principles and they are directness, cohesion, safety, comfort, and attractiveness. Every Dutch city is built and developed around these principles. (NL-5) indicated that for some cities it is getting difficult to improve the cycling infrastructure as it is already world-class and sometimes the administration has to find valid reasons to invest in it. The country has a habit of experimenting to see what works and what does not and then gaining an understanding by observing the patterns (NL-7).

Safety

Several countries are working to increase biking safety in an effort to lessen the substantial health cost brought on by bike accidents and to encourage more individuals to start cycling as the partial absence of valued safety discourages individuals from doing so (Schepers et al., 2017). As bicycles regularly travel in tandem with larger, quicker automobiles, cyclists are considered to be particularly susceptible to accidents. Cycling infrastructure attempts to increase riders' convenience and safety (Mulvaney et al., 2015). Schepers et al. (2017) pointed out that according to the Dutch street layout, there shouldn't be many disparities in mass, speed, or direction. For instance, a secure speed for combining motorized and bicycle activity is limited to 30 km/h. On distributor roads, the speed restriction is 50–70 km/h, the goal is to segregate motorized traffic from bicycles with bicycle lanes and reduce the speed of the motorized vehicles at crossings. For different road classifications, the speed restrictions and the positions of bicycles are shown in the table below.

Road	Speed limit in urban areas	Location of cyclist
Access roads	30km/h	Mixed with other traffic
Distributor roads	50 or 70km/h	Separated from motorised traffic by bicycle paths or lanes
Through roads	100 or 120km/h	Cycling not allowed

Table 7: Speed limits and classification of roads in the Netherlands (Schepers et al., 2017)

As for the findings from the interviews, multiple respondents mentioned that the administration has created traffic-calming neighborhoods for cars so that they can't cross a specific speed, mostly 30km/h, and cyclists feel safe while cycling (NL-2, NL-3, NL-5). This is also mentioned in the above paragraph and in table 7. It was also mentioned by (NL-2) that the government has a national plan to enhance road safety for cyclists and cities follow that to create the infrastructure that promotes the safety of cyclists. Furthermore, two important factors regarding safety were also emphasized upon and they were, most of the car drivers are also cyclists in the Netherlands and which helps in improving the safety of cyclists as the car drivers can relate to the cyclists (NL-3), and secondly, the Netherlands has almost perfected the idea of intersections that are protected so the cyclists feel safe while taking turns and riding on roundabouts (NL-4).

Practicality and Accessibility

The convenience of reaching a location might be referred to as ease of access. Even though the majority of mobility systems are focused on improvements that cater to automobiles, increasing accessibility has lately emerged as a key goal for urban planners. According to earlier studies on cycle access, users generally rule out possible locations simply because they are too far away or would take too long to get there (Saghapour, Moridpour, & Thompson, 2017). The concept of a 15-minute city has been adopted by authorities across the globe. This idea suggests creating a city whereby people may get the basic necessities they require close to their homes by biking or on foot (Hosford, Beairsto, & Winters, 2022).

Interviewees (NL-1, NL-3, NL-5, NL-6) mentioned that bikes are widely available in the country for a cheap price and it is easy to maintain them. Almost all the people living in the Netherlands can buy a bike easily. There are also initiatives for people who can't afford to buy a bike. Hence, accessing a bike is fairly easy. Almost every need of most people is accessible by bike. If something is 20 minutes away by walking, it is only 5 minutes by bike and this makes people cycle as it is efficient and convenient

(NL-1, NL-5). The distances are short for every need like grocery stores, hospitals, and schools so people prefer to cycle (NL-2, NL-4). This also relates to the 15-minute city concept discussed in the above paragraph and was mentioned by some respondents. Many people in the Netherlands do not have a car as everything is doable by walking, biking, or a combination of biking and public transport. Also, there are a lot of (international) students and young people who can't afford a car so it is practical to buy a bike (NL-2, NL-7).

Soft Factors

Social Acceptance and Early Learning

The study on the choice of mobility has revealed the growing importance of socialization variables that are related to travel. This involves the impact of certain experiences, like relocating to a new transport environment as well as the conventions and actions of friends and family (Haustein, Kroesen, & Mulalic, 2020).

Interviewees put forward that cycling is a very normal thing to do and it doesn't matter whether people are rich, poor, old, or young. Useful things such as mudguards, luggage racks, and lights are built in cycles so people just think that it is normal. Cycles are a part of Dutch identity and a tool that they use on a daily basis just like any other tool used in daily life (NL-4, NL-5). Moreover, it is also just fine to leave a bike at a spot that is not designated for bike parking as people and authorities are generally accepting of it. The culture of biking is such that people of a certain demographic who don't bike, often feel left out as it is deeply imbibed in the Dutch culture. On a mental level, people feel that they are missing out on something (NL-1, NL-7). Learning to cycle at an early age is a part of the Dutch culture. Respondents highlighted that children learn cycling at a very young age and some cycle in the backyard or empty streets in front of their parents before they go on the road and cycle independently, at the age of 5 or 6 (NL-2, NL-3, NL-6, NL-7). Children get lessons about cycling and road safety in primary school and they also take a practical exam in which they have to cycle some specified routes and there are people observing them along the way if they are cycling in an appropriate manner or not (NL-3, NL-4, NL-7).

Healthy Lifestyle

There are several health advantages to engaging in consistent movement. Walking and cycling have drawn emphasis from various sectors as they are environmentally friendly and save land usage as well. A study was conducted related to the active transport behavior across various countries. The results suggested that considerable

changes in travel behavior in England would have a significant influence on wellness and health. Considering other factors as equal, implementing a degree of active travel equivalent to those of Switzerland or the Netherlands would avoid roughly 6-10% of all fatalities brought on by illnesses linked to lack of exercise, in addition to 3-4% of all fatalities from any other reason (Götschi et al., 2015).

Few respondents pointed out the health benefits of a higher cycling adoption rate. (NL-3) argued that cycling is healthy for the body and when you are driving a car, you need to fully concentrate on driving, but it is not the same with cycling. It is a bit different and more of a joyous activity while being inclusive at the same time. It also benefits the country in various ways such as the government and people saving money on health spending. It was also pointed out by (NL-3, NL-5) that the Netherlands is one of the most healthy countries and there are not many overweight people. Furthermore, a healthy lifestyle is an important byproduct of high cycling rates in the Netherlands and it also has a positive effect on the environment and surroundings (NL-7).

5.1.2 The Indian Perspective

Numerous key factors, hard and soft, were discovered that discourage cycling in the National Capital Region of India through the examination of the information gathered from interviews. The factors elucidated below are not in any specific order and certain convergence among factors might be present due to the nature of the study and the information provided by the respondents.

Hard Factors

Infrastructure

An enormous increase in personal automobiles has been caused by the underdeveloped public transportation infrastructure. As a result, there is high traffic and greater power utilization, which raises prices and contributes to air contamination (Das & Parikh, 2004). Cycling is dangerous due to a number of problems, including inadequate or nonexistent bike facilities, rapidly increasing vehicle traffic, and alarming air pollution rates. There is almost no infrastructure for cyclists resulting in high fatality rates. Cyclists make up 10% of all fatalities while their share on the road for journeys is a mere 5% (Apparicio, Gelb, Jarry, & Lesage-Mann, 2021). Given that Delhi's road space accounts for 21% of the city's overall surface area, far more than places like Tokyo (13%), and Hong Kong (12%), the fast growth of the road system is bound to be extremely unhealthy. Additionally, the amount of available roadway capacity has

decreased by half, from 12 km/1000 cars in the early 1990s to roughly 6 km/1000 automobiles in 2005, causing severe jams on urban highways and growing amounts of pollution from traffic (Chidambara, 2016).

Regarding the findings, a couple of interviewees (IND-1, IND-4) mentioned that the National Capital Region of India does not have segregated cycle paths so people do not feel safe while biking. The traffic mix in the region also does not make it very safe for people to cycle as it is mostly a car-dominated region along with big trucks because it is economically a very important region in India. Furthermore, there are bullock carts and horse carts that are roaming around the streets and this creates extremely undesirable conditions for cycling and it is not even safe with appropriate cycling gear. Hence, people feel unsafe to cycle on a daily basis. Another point that was made is that people who cycle or who want to cycle are simply discouraged to do so because they don't know where to park their cycles when they reach the destination. There is a dearth of secure bicycle parking in the region. There is no provision to take bikes in the metros so last-mile connectivity is a major issue that needs to be tackled as it can be economically beneficial for the government and people (IND-1, IND-4, IND-7). Moreover, it was highlighted that the National Capital Region of India is an urban agglomeration that includes various cities like Delhi, Noida, Gurugram, and Ghaziabad among a few others. A lot of people travel from Delhi to other parts of the region for work on a daily basis. Some travel by private vehicle and some travel by public transport that includes the metro and bus. It is not possible for them to cycle from their home to their respective workplace as the distances are large to cover on a bicycle. This is one of the important reasons that the share of cars in Delhi has exploded in recent decades (IND-2). The majority of the findings from the interviews correspond to the literature mentioned in the above paragraph regarding the traffic mix, share of road space, safety of cyclists and infrastructure related to it, among other aspects.

Integration With Other Modes of Transport

Combined public transportation infrastructure, which combines multiple modes, is universally acknowledged as having a significant impact on the efficiency of transportation. These interconnected networks are designed to offer flawless transportation through a practical, approachable, secure, and reasonably priced system. These networks enable multiple forms of transportation to work in harmony rather than in opposition to one another. Consequently, the creation of seamless connectivity has been suggested as a potential remedy for the growth of private car activity on Delhi's road networks (Chalumuri, Nath, & Errampalli, 2018). It is argued by Kumar, Jain, Kulkarni, and Parida (2010) that any public transportation system must have both ac-

cessibility and access, which are two separate attributes. The ability to utilize public transportation is access to it. Accessibility refers to how quickly people may travel from their starting place to their departure place via public transit. Hence, accessibility includes how well local transportation works. Access has a significant influence on the public transit network and facilitates the accessibility of services.

Regarding transport integration, interviewees mentioned that the multi-modal integration of transportation is in bad shape and it needs to be streamlined in order to stimulate non-motorized forms of transport (IND-2, IND-7). The first-mile and last-mile connectivity is lacking in the region as people who travel by metro or bus pay for taxis to get them from their homes to the nearest metro station or bus stop (IND-3). A respondent (IND-4) pointed out a critical point that the region does not have a dedicated transport body that monitors different forms of transport. For instance, London has Transport for London (TfL) and Singapore has Land Transport Authority (LTA). Such bodies are crucial as they can integrate numerous means of transport and plan the regions accordingly by having a dedicated vision of how transportation should function in a specific area. Hence, public transport and its integration need to be prioritized if the region is to be made friendly for active forms of transport (IND-7).

Soft Factors

Lack of Awareness

Tyagi and Raheja (2021) emphasized that a large percentage of youngsters in India fail to participate in the required one hour of daily moderate to vigorous physical activity (MVPA), which has been scientifically linked to negative health consequences both in infancy as well as later in adulthood. While having social and physiological advantages, this kind of exercise has traditionally been disregarded and is rapidly disappearing in India. The causes of this issue include a lack of integrated environmental backing, families' unfavorable opinions of neighborhood safety, and a rise in vehicular traffic (Tyagi & Raheja, 2021).

Multiple respondents pointed out this factor in a varied manner. (IND-2) highlighted that having good road and metro infrastructure is a matter of pride for cities and there are many cities in India that do not have high metro ridership but still metro system was developed as it is seen as checking one of the important urban development parameters. Also, people think that by building flyovers, car traffic will reduce but this does not happen in reality. It is basically diverting the traffic to another junction, but the traffic still remains and in another sense, this encourages more people to drive a car. It was also mentioned that people don't realize that by building expressways

and highways, the regulatory bodies are eventually promoting high-speed corridors for private vehicles. This increases the chances of fatal accidents as well. The money invested in building these corridors is huge and with a small fraction of this money, multiple cycling networks can be developed (IND-2, IND-4). The same point was also mentioned by (NL-4) that only 3% of the total transportation budget of the Netherlands is spent on cycling and it makes a huge difference. Moreover, there have been cases where the administration has built lanes for cycles by painting them, but the very next day you see people driving over them, and street hawkers are doing business on them, among a few other things (IND-4, IND-5). Moreover, if an occupancy assessment is conducted in busy areas of Delhi, there would be a lot of cars each having about 2-3 people, whereas, if buses transport these people from one point to another, there will be much less traffic on the roads (IND-2). Also, many people in Delhi drive cars in a rash manner which results in cyclists feeling unsafe, thereby further demotivating people to cycle in their daily life. Unfortunately, people who cannot afford any other form of transport still cycle in a hazardous environment to earn a living (IND-7).

Social Status

While cycling for commuting is viewed as a common practice in countries like Denmark and the Netherlands, many individuals in other developed nations with modest biking rates think that bicycling is strange or unattractive. Bicycles and public transit are stereotyped in various nations in Asia because cycling is a popular form of transportation for people who can't afford a motorized vehicle, whereas cars are seen as a sign of prestige (Haustein, Kroesen, & Mulalic, 2020).

In the findings from the interviews, many respondents mentioned that owning a car is a status symbol in the entire country. Even if a middle-class person cycles on a regular basis, it is common for people to think that person is not rich enough to afford a car or a motorbike. It is also the Indian mindset that has been fed across generations that owning a car and a house indicates that he/she is successful. Furthermore, cycling in India is not considered normal as is the case in the Netherlands (IND-1, IND-2, IND-4, IND-6, IND-7). Also, people who are economically sound only use cycles for recreation and not for daily transit due to the reasons discussed above (IND-7). Social perception is also important concerning a specific aspect. There are food delivery riders that deliver food by e-bikes. Unfortunately, this is also looked down upon, and often people think that the food delivery rider should at least have a motorbike so that he can deliver the food faster among various other reasons. The sustainability angle is not what comes to people's minds (IND-2, IND-4). The Case of Amsterdam and Copenhagen (Chapter 4) implies that cycling is used for getting people from point A to point B and is for all types of people in society.

Environmental Conditions

Many Indian metropolises now have exceptionally elevated pollution emissions. Delhi is one of the most polluted cities in the world and the largest source of smog in cities is the transportation industry. In Delhi, the percentage of automobiles in the overall pollution impact reached 64% in the 1990s. Later, this percentage in Delhi rose even more to 70% (Das & Parikh, 2004). Regardless of its many acknowledged advantages, cycling in cities can present dangers to one's health due to excessive traffic, susceptibility to air contaminants, and sound from passing vehicles. It is widely acknowledged that poor air quality and high noise pollution can seriously damage health and affect prosperity. Bicyclists breathe in larger amounts of air contaminants than walkers, people with private vehicles, and passengers on public transportation due to their greater degrees of respiration speeds (Apparicio et al., 2021). Severe weather is possible everywhere, but when it does so frequently, it can have a disastrous effect on the ecology and the economic health of the area. As an example, the catastrophic flooding in Chennai as well as several regions of Tamil Nadu, India, during late 2015, impacted countless people's ability to go about their daily lives normally (Manikandan, Das, Mukherjee, Sehgal, & Krishnan, 2019).

Respondents in the interviews also underscored the harsh environmental conditions that have badly affected the National Capital Region of India. It is one of the major reasons that inhibit people to adopt cycling as one of the primary modes of transport or combine it with the already existing metro system. Summers are excruciatingly hot and winters are equally stark in the region. Due to climate change, monsoon comes announced and roads get clogged with water and cycling is practically not possible. People who travel their last mile on foot also face a problem getting their clothes ruined before they reach their workplaces due to extreme weather, so a comfort factor is also important for people who can afford a four-wheeler (IND-1, IND-5). A couple of respondents also mentioned that infrastructure needs to be developed in such a way that it boosts cycling and minimizes the effect of climatic conditions as a factor. This will also result in the minimization of accidents (IND-2, IND-3).

5.1.3 Structural Dimensions and Functions of TIS

This section aims to compare the structural dimensions and functions of TIS (section 2.2.1) between both countries. To do so, the findings from the interviews were used for both, India and the Netherlands. The first paragraph discusses the findings from the interviews with Dutch experts and the second paragraph discusses the findings from the interviews with Indian experts.

If the findings of the interviews from the Dutch experts are to be focused on, most of the structural dimensions and functions of TIS are present and/or interrelated with each other. *Actors* like the government and municipalities are *Mobilizing Resources* for creating safe and good infrastructure for cyclists so that they are motivated to do so which leads to the *Creation of Legitimacy* and *Market Formation*. The *Creation of Legitimacy* can also be observed as the *Institutions* function in a way decided by *Interactions* among stakeholders. The structural dimension of *Infrastructure* and *Entrepreneurial Activities* function is observed in the factor of Practicality and Accessibility as bikes are easily available across the country and many times, it is practical to travel by bike instead of choosing a motorized transport. The Early Learning factor in the Netherlands relates to the *Knowledge Development* function as children are given cycling lessons and they even take practical exams for the same. It was also observed in the Healthy Lifestyle factor that *Interactions* between *Actors* result in *Knowledge Development* and *Knowledge Diffusion* as some respondents pointed out the health advantages of cycling and that the Netherlands is one of the healthiest countries on the planet. This also denotes *Guidance of the Search* function as the government is prioritizing cycling due to its health and economic benefits.

Moving on to the findings from the interviews with the Indian experts, there are numerous functions that are lacking. Firstly, *Resource Mobilization* is absent as funds are being used to develop expressways and highways for cars. This results in a lack of *Guidance of the Search*. The weak integration with other means of transportation denotes that it is difficult for people to adopt cycling as one of the primary modes of transport as the distances are too big to travel only by bike, resulting in the lack of *Legitimacy Creation*. It was also observed that since people who cannot afford to buy cars or motorbikes use cycles in their daily life that signifies *Entrepreneurial Activities* are present in the Indian context and there is some *Market Formation* as well. The Lack of Awareness and Social Status soft factors denotes *Knowledge Development* and *Knowledge Diffusion* is not present in the Indian context as *Actors* are not Interacting to spread awareness about the benefits of non-motorized transport, especially cycling. Cycling infrastructure is not a development parameter for most people in the National Capital Region of India and hence, car-centric infrastructure is being developed. This results in *Institutions* acting poorly to promote cycling. Moreover, people do not have easy access to cycling due to a lack of infrastructure, unsafe environment, and poor environmental conditions (*Infrastructure*).

A schematic overview of how the structural dimensions and functions are linked to each other in both countries and what function is present or absent is shown in the figure below. Connecting arrows are given different colours to improve the traceability of the relation between structural dimensions and functions of TIS.

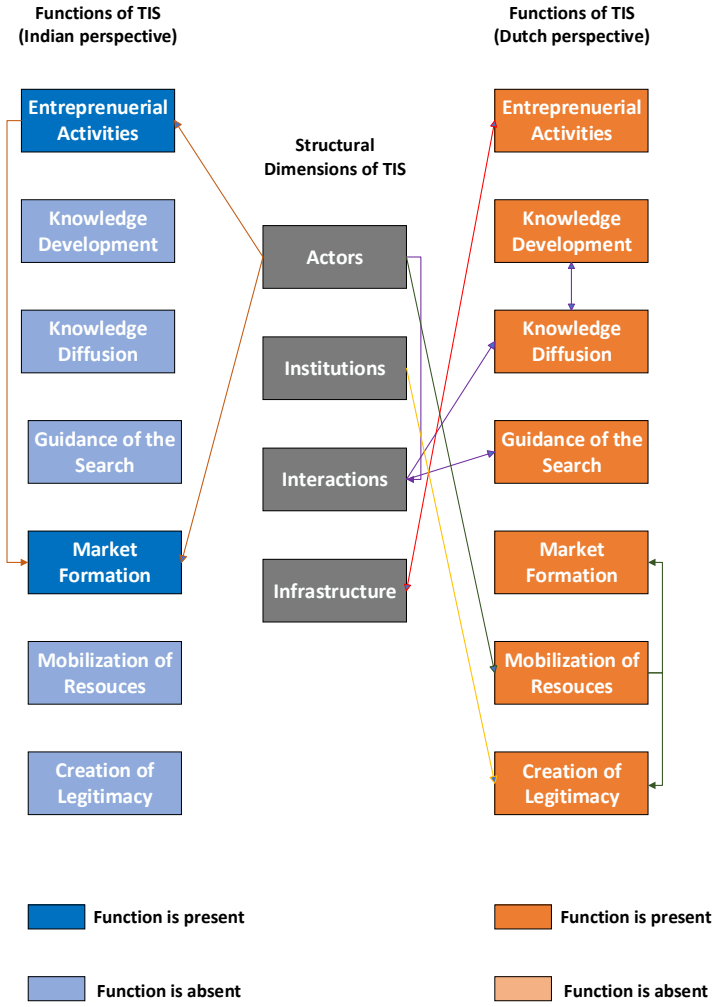

Figure 8: Structural dimensions and functions of TIS regarding the factors affecting cycling adoption

5.2 Impact of Regulatory Bodies in Cycling Adoption

The factors discovered in this section are interrelated to the factors discovered in the above section 5.1 in some or the other way. For instance, safe infrastructure can be developed when multiple stakeholders collaborate and the government is showing the willingness to do so. Another example is that cycling will seem practical to people if the authorities are keen on developing policies that foster cycling and makes car driving impractical in some occurrences.

5.2.1 The Dutch Perspective

Various relevant factors related to the impact of regulatory bodies were discovered that encourage cycling in the Netherlands. These factors were identified through the

analysis of the data acquired from interviews. The factors discussed below are not in any particular sequence and because of the nature of the study and the data offered by the interviewees, there may be some convergence among the factors.

Collaboration Among Stakeholders

Strategic collaborations are groups of entities that band collectively to tackle complex issues that are generally too complex for a single entity to handle on its own. These collaborations serve as social solutions to issues amongst groups from various sectors. Partnerships are often lauded as advantageous and occasionally essential for attaining advancement (Savage et al., 2010).

Concerning the findings from the interviews, (NL-2) mentioned that cycling is taken seriously in the Netherlands and there are many policies in and around it. Mayors, deputy mayors, and city councils are only some of the key actors responsible for inclusive and encouraging cycling policies. The Dutch cities and provinces have a good amount of autonomy to design their own infrastructure which is still lacking in many countries (NL-7). This is how infrastructure is improved incrementally. Cyclist union has played a pivotal role in making the Netherlands a cycling-friendly nation as shop owners in the past have rejected the idea of making neighborhoods cycle friendly as they thought no one would come to their shops and they will eventually have to close their businesses. However, the cyclist union pushed for safer streets for cyclists and the result is for everyone to see. Nowadays, shop owners don't want cars near their shops as they believe that cars will reduce the customers they get for their businesses. Moreover, there is a manual for cycling that standardizes most of the facets and this is the reason why cities in the Netherlands are similar in terms of cycling infrastructure and features related to it. A cross-party consensus is key to having the highest cycling rate in the world (NL-1). Furthermore, the newly opened underwater cycle parking facility in front of the central station of Amsterdam cost nearly 60 million euros, but its objective not only included increasing the number of cycle parking racks, these are public space improvement projects and thereby enhancing the livability of the city. Various stakeholders have also made sure that infrastructural development and policies around cycling go hand in hand and this is the reason that the integration of different forms of transport in the Netherlands is excellent. Such results are also similar to the theory in the above paragraph which mentions that complex issues require a collaboration of stakeholders and cannot be tackled by one (NL-4). The Stop de Kindermoord campaign was mentioned by (NL-2) and (IND-7) when giving an example of the Netherlands and the role of the people in demanding safe infrastructure for cycling. This campaign is also discussed in section 4.2 and how various stakeholders collaborated to promote cycling.

Political Will

Interviewees highlighted this factor as one of the most important ones. There have been huge investments in cycling infrastructure in recent years to make it more attractive for people in numerous ways (NL-1, NL-7). Two respondents (NL-2, NL-3) indicated that people in the Netherlands have been very vocal about their demand for good cycling infrastructure for a long time as the Netherlands had one of the highest rates of accident deaths in Europe. Fortunately, the government listened to them to enhance cycling in the country and this was partly due to the oil crises in 1973, which also resulted in the introduction of car-free Sundays to promote cycling. These findings are in accordance with the discussion in Chapter 4 (The Case of Amsterdam and Copenhagen). (NL-2) also underscored the importance of finding a balance between spaces for cycling and cars. There are people who want space for their cars to be parked and there are people who want to live in low-car neighborhoods. Hence, it is on the administration to strike a balance between the demands of the people as they are the ones having the voting power. A couple of respondents (NL-4, NL-5) argued that people are important stakeholders but it is the leadership at the governmental level that has played a significant role in the cycling adoption around the country by consistently promoting cycling and resisting the urge to design their cities around cars. This was also emphasized by multiple Indian experts (IND-2, IND-5, IND-7). It has taken almost 50 years of political decision making and today people are reaping the benefits of the same.

Cycle Friendly Policies

According to multiple experts, buying and maintaining a car is expensive in the Netherlands as parking costs are very high in cities like Amsterdam, so people instead choose not to opt for a car. Also, the money collected from parking fees and fines is invested in building a cycling network and infrastructure (NL-2, NL-3). Policymakers are not only making cycling desirable but making driving a car less desirable and inconvenient within the city by pushing car traffic to the perimeter of the city so it is not going through the residential areas within the city (NL-2, NL-4, NL-5). Car journeys are also designed in a way that is indirect and takes longer to complete a trip through modal filtering (NL-7). There are motorways around many cities in the Netherlands that are built with the aim to reduce car traffic within the city so that it helps cyclists. It is also no longer allowed for mopeds to drive on the cycling lanes in cities like Amsterdam to make it safer for cyclists (NL-2). If the car hits the cyclist, the car driver has the first responsibility for the accident unless proven otherwise (NL-2, NL-6). Cyclists have the right of way at the roundabouts so they don't have to stop which motivates people to cycle instead of traveling by car (NL-3). Altogether, cycling policies and car

policies are extremely important along with spatial characteristics of cities as people won't cycle if the distances are too long or impractical to be done on a bike (NL-2).

5.2.2 The Indian Perspective

Various relevant factors related to the impact of regulatory bodies were discovered that identify what is being done with regards to cycling and what are the barriers to cycling adoption in the Indian capital region. These factors were identified through the analysis of the data acquired from interviews. The factors discussed below are not in any particular sequence, and because of the nature of the study and the data offered by the interviewees, there may be some convergence among the factors.

Political Commitments

Das and Parikh (2004) pointed out that the transportation industry receives around 12-15% of the total national expenditure. However, a large portion of this money goes to building highways and expanding rail capability, giving a small amount to municipalities to enhance urban mobility. Even with the Mass Rapid Transit System (MRTS), the metro system, 8.8 million cars were predicted to be on Delhi's roadways by 2020. Substantial expansion in private transportation, including automobiles and motorcycles, is anticipated as a result of increasing wealth. In 2020, about half of the mobility needs were met by a motorized private vehicle (Das & Parikh, 2004).

Multiple respondents emphasized this factor as one of the crucial ones. There has always been a push for making more roads, highways, and flyovers in the NCR and not prioritizing walking or cycling. One of the perceived key factors for development in India is the infrastructure for automobiles and this enable the decision-makers to focus on building more and more roads, expressways, and so on (IND-2, IND-4). There is a Comprehensive Mobility Plan for every major city in India and for Delhi, the focus has been on developing metro systems as it is also considered a factor for development just like road infrastructure. The Ministry of Housing and Urban Affairs also provides funds for such mobility projects as it is seen as a sign of development in the eyes of people because they are the ones who have the voting power to decide the government. The decision-making is politically driven for the most part and unfortunately, it is far from the ground reality. It is also argued that if the administration provides requisite infrastructure that meets the safety standards, most probably, people will cycle and that has been the case with some European nations as well (IND-2). There is also an automobile lobby which has made motorized vehicles accessible and made active forms of transport less attractive so that cars and motorbikes can sell more (IND-7). It was also put forward by (IND-3) that policies are required to create parking spaces

near the metro stations so that people don't pay on a regular basis for first and last-mile connectivity. This can enable people to select cycling as one of the transport modes in their daily lives. Moreover, four interviewees mentioned that authorities understand the benefits of cycling and walking, but the real problem is when they have to act on the ground. Governments have not taken any bold steps in implementation as it can risk political performance (IND-4, IND-5, IND-6, IND-7). Along with that, people have to pay taxes when buying a cycle, however, electric cars are incentivized by the government which shows what mode of transport the government wants to promote (IND-7).

Promotion of Cycling

Interviewees mentioned that it is vital for the government to create cycle-friendly policies such that people are encouraged to cycle on a daily basis and not only for leisure. The administration needs to campaign to show the benefits of cycling, show it as a feasible way to go from one point to another, and that it is not only for the poor. It is key for municipalities to act as cycling adoption cannot increase without acting at a local level (IND-1, IND-6). Dutch municipalities have also acted in a similar way to make cycling practical. The government needs to consult experts and researchers about promoting cycling in the region as the case of Delhi and surrounding regions is quite different than what we have for other success stories like The Netherlands and Scandinavian countries (IND-2, IND-6). Along with it, the government needs to stimulate cycling by allocating a requisite budget for it. In order to achieve carbon neutrality, electric mobility has been boosted by providing sufficient funds and other resources but the same cannot be said for cycling and walking which are essential to tackle climate change (IND-2, IND-4). As for the promotion activities that have been done by the administration, The Ministry of Housing and Urban Affairs has promoted cycling through several initiatives like the Cycles for Change Challenge in cooperation with Institute for Transportation and Development Policy (ITDP). Some markets are also pedestrianized in Old Delhi (IND-2). An interviewee (IND-4) also mentioned that the Dialogue and Development Commission of Delhi (DDC), which is under The Government of Delhi, launched a program named Reclaiming Street Design which focused on growing the green cover and allocating space for cyclists and pedestrians, among other initiatives. Such initiatives also help in spreading awareness about cycling and walking and the benefits related to them.

Continuous Improvement

Respondents indicated that the National Capital Region of India is a huge region, both population-wise, and area-wise, so it is imperative for the administration to take a

step-by-step approach to enhance the conditions for cycling. Being an IT hub, Gurugram in the state of Haryana can be a good starting place as the population mix is well-educated and young and the workplaces are also not too far from others (IND-1, IND-3). An interviewee also mentioned the psychological aspect of the Indian population. Continuous improvement is important because, in India, people need to see that the infrastructure is improving and then only they will try out cycling on a regular basis. For instance, when the respondent lived in Delhi, near a busy metro station, bikes were parked in an extremely messy way and such visuals do not motivate people to use bikes as one of their primary means of transport (IND-1). Demand management for each form of transport and the use of the resources in an appropriate manner is vital for the National Capital Region of India as the characteristics of the residents vary a lot in terms of living standards and income. The application of a transport mode changes as income increases. Hence, it is crucial to focus on a specific set of audiences and then improve incrementally (IND-2, IND-3, IND-5). Incremental improvement has been also seen in Dutch municipalities. Furthermore, the administration needs to look at the average trip length across the region and there are areas where it is short so the entire trip can be done on a bicycle. The fundamental understanding of a trip that can be done completely with a bicycle or bicycle will only be used for first-mile and last-mile connectivity is the key from the governmental point of view (IND-6). The administration has been successful in promoting the electric vehicle share in India at a decent rate. The Union Territory of Delhi and states like Uttar Pradesh have been aggressively promoting electric vehicles and the same reasoning can be adopted for cycling and walking (IND-2, IND-4). Additionally, it was also mentioned that Indian Road Congress (IRC), responsible for designing the streets in India, should also have a specific set of guidelines to design the streets in a better way. Presently, they have a budget for street development, but no budget for non-motorized transport. Lastly, policy documentation is required which can guide the officials about the direction in which the infrastructure needs to be developed (IND-6).

5.2.3 Structural Dimensions and Functions of TIS

This section compares the structural dimensions and functions of TIS (section 2.2.1). The results of the interviews were applied to both India and the Netherlands in order to achieve this. In the first paragraph, the results of the interviews with Dutch experts are discussed, and in the following one, the results of the interviews with Indian experts are discussed.

With regard to the interviews with Dutch experts, a good amount of *Interaction* can be observed among *Actors*. Firstly, cycling is taken seriously and there are a set of

rules and policies around it, i.e., *Institutions* and *Mobilization of Resources*. This also gives motivation to people to engage in *Entrepreneurial Activities*. As noted in the factor, Collaboration Among Stakeholders, activists and people, i.e., *Actors*, demanded development catered to cyclists, i.e., *Infrastructure* and the government *Interacted* with them and listened to them. The administration *(Actor)* showed political will to build cities that are safe for cycling and tried to merge existing policies to make them more friendly for cyclists and discourage car usage *(Creation of Legitimacy)*. It was on the administration and regulatory bodies *(Actors)* to make sure *Knowledge Development* and *Knowledge Diffusion* takes place appropriately in order to spread awareness about the developments in the cycling policies and along with, the development on the infrastructural side *(Interaction)*. As mentioned in the factor, Cycle Friendly Policies, the government *(Actor)* has prioritized cycles over cars, especially inside cities, and this show that there is a *Guidance of Search* that is present. The *interaction* among people and the administration *(Actors)* has made sure that *Market Formation* function of TIS is present in the Dutch scenario as the Netherlands boosts one the highest cycling rates in the world.

Regarding the interviews with Indian experts, the observations are in stark contrast to the Netherlands. Partly due to a lack of awareness among people *(Actor)*, nobody is demanding good cycling infrastructure which denotes that the TIS function of *Guidance of Search* is absent. It can also be seen in the factor, Political Commitments, the government *(Actor)* has prioritized cars over cycles by building highways and high-speed corridors, therefore making the functions *Guidance of Search* and *Mobilization of Resources* absent. Promotion of cycling has been done through different initiatives *(Interaction)* as discussed in the factor, Promotion of Cycling, and it shows *Knowledge Development* and *Knowledge Diffusion* is present in the Indian context. Many people who cannot afford a motorized vehicle are forced to cycle which creates some *Entrepreneurial Activities* and *Market Formation* in the region. The TIS function of *Creation of Legitimacy* is also missing due to a lack of policies and guidelines for non-motorized modes of transport as discussed in the function, Continuous Improvement.

A schematic overview of how the structural dimensions and functions are linked to each other in both countries and what function is present or absent is shown in the figure below. Connecting arrows are given different colours to improve the traceability of the relation between structural dimensions and functions of TIS.

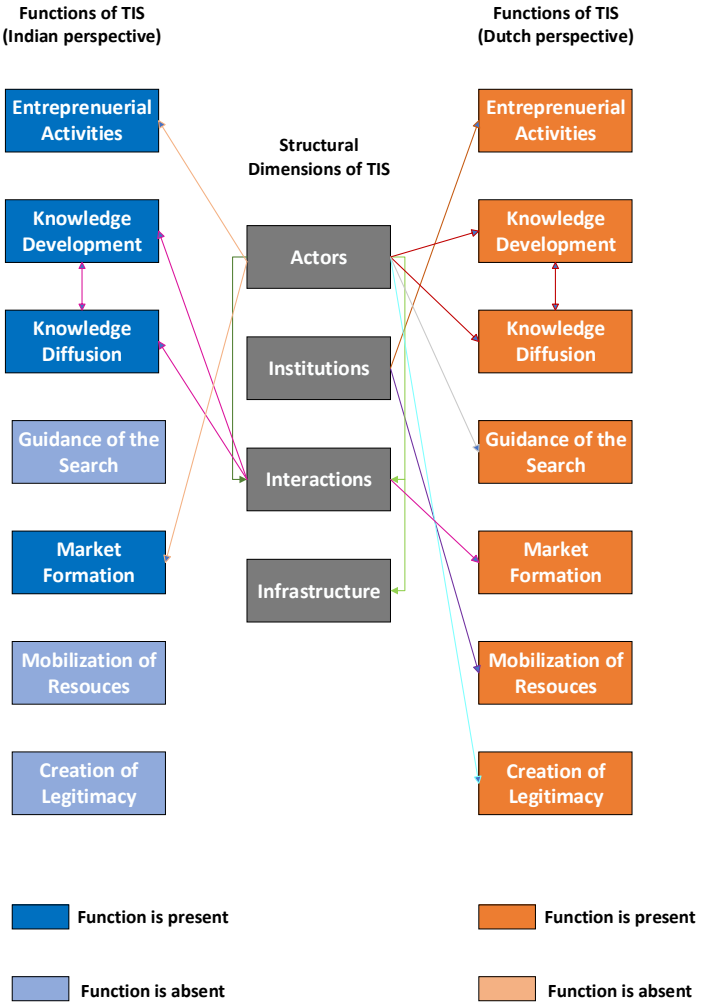

Figure 9: Structural dimensions and functions of TIS regarding the impact of regulatory bodies in cycling adoption

5.3 Role of Firms in Cycling Adoption

This section describes what firms in the Netherlands and India are presently practicing and in the case of India, how they can influence cycling adoption.

5.3.1 The Dutch Perspective

Some pertinent factors about the role of different firms to foster cycling in the Netherlands were found. These factors emerged once the data from the interviews were analyzed and are not in any specific order.

Organizations

There are several organizations that promote cycling in the Netherlands. The Dutch Cycling Embassy works with partners from around the world in the field of cycling to spread awareness and knowledge about cycling and its benefits. Also, people from other countries are invited to see and learn from the Dutch cycling model as it is considered the best in the world. Research organizations are working to show the benefits of cycling and the cyclists union (Fietsersbond) has always campaigned for cyclists. There are organizations that give cycling lessons to people who migrated from abroad or who are not used to cycling (NL-3, NL-6). As for other private organizations that are not in the field of cycling, many give an allowance if their employees travel by bike to work and some also have opened up private bike parking spaces for their employees in or near their offices. Some companies also give an allowance to buy a bike in order to promote sustainability. Many companies provide a business OV chip card so they don't have to provide car parking spaces. Some provide showers and changing facilities so that employees can get fresh after they have cycled to work (NL-3, NL-4, NL-5).

Promotion of E-Bikes

An interviewee pointed out that the private cycling industry is promoting e-bikes as it is a lucrative business for companies and people can cover longer distances in a short time. Also, e-bikes enable old aged people to cycle easily and it expands their reach as well (NL-1). The adoption and popularity of e-bikes have resulted in authorities developing longer cycling routes and increasing parking spaces across the country (NL-4, NL-7). In recent statistics, e-bikes accounted for half of the sales of all bicycles sold in the Netherlands in terms of revenue, but the number of e-bikes sold is still lower than the normal cycles sold (NL-6).

5.3.2 The Indian Perspective

Some pertinent factors were found regarding what firms are practicing when it comes to increasing cycling adoption. These factors emerged once the data from the interviews were analyzed and are not in any specific order.

Bike-sharing System

Bike sharing program is one of the first steps in increasing the share of journeys made by bicycles in India. Patel and Patel (2020) argued that owing to its cutting-edge architecture, the idea of public bicycle sharing has altered popular opinion in a positive

sense. It is a system that provides cycles accessible to a number of people on a shared basis for brief rides with the possibility of leaving those at various locations. By introducing it, passengers will have an alternate form of mobility for the final stretch of their journey, which was traditionally accessible only by other means of transit. In contrast to wealthy nations, bike-sharing programs are still in their infancy in emerging economies like India. In addition, these nations confront several obstacles when it comes to funding and governance (Machavarapu & Ram, 2022b). In the last five years, over a dozen cities have been preparing to introduce a public bike-sharing program. It is seen as the first crucial stage in establishing the shift to a non-motorized form of transportation (Sharmeen, Ghosh, & Mateo-Babiano, 2021). The main barriers to the expansion of cycle sharing in India are considered to be the populace's dearth of information and bad impression of riding, poor network, and under-funding among many others (Chopdar, Lytras, & Visvizi, 2022). Machavarapu and Ram (2022a) pointed out that additional study is required on bike splitting, particularly in nations such as India where little information exists on the subject.

The respondents pointed out that bike-sharing systems are on the rise in Delhi, and many companies are venturing into the same. Most of them are installed near busy places like metro stations, markets, tourist attractions, etc. Furthermore, there are numerous providers across the region that provide a fleet for the delivery of e-commerce and food (IND-1, IND-2). Some of the challenges that the bike-sharing system is facing presently are the viability gaps for the business model as India is a price-sensitive market, hence the charges need to be extremely low for people to try the bike-sharing system (IND-6).

Organizations

According to multiple respondents, there are many organizations that promote cycling. Some are involved in leisure activities like cycling clubs in which people cycle every or alternative weekends for recreation. Some have taken inspiration from other countries by offering bike tourism in which they take people to biking trails and promote cycling (IND-1, IND-4, IND-5, IND-7). There are several top engineering universities like the Indian Institute of Technology (IIT) in Delhi, Chennai, and Mumbai where cycling infrastructure is quite good and automobile vehicles are not allowed inside the campus. There are cycles docked at multiple locations within their campuses and if someone wants to go around the campus, they either use these cycles, use their personal cycles or they walk (IND-2, IND-7). There are many e-bike providers across the region which have an app-based system, similar to European countries, where people can unlock the bike by paying and ride it for a specific time and later dock it at one of the nearby stations (IND-3). More schools need to focus on topics

like climate change and the importance and benefits of non-motorized forms of transport. By doing this, the future generations can get aware of these problems at an early age (IND-2). (IND-6) mentioned that Civil Society Organizations (CSO) and Public-Private Partnerships (PPP) need to campaign at the right place in order to change the perception of people and it has to start at a regional level and gradually move towards a national level. A bottom-up approach is required from such organizations in which the influencing bodies realize that people are demanding good cycling infrastructure and then it can have positive outcomes.

5.3.3 Structural Dimensions and Functions of TIS

The structural dimensions and functions TIS (section 2.2.1) are contrasted in this section. This was accomplished by applying the interview findings to both India and the Netherlands. The findings of the interviews with Dutch experts are reported in the first paragraph, and the outcomes of the interviews with Indian experts are detailed in the paragraph that follows.

Concerning the interviews from the Dutch experts, *Knowledge Development* and *Knowledge Diffusion* is clearly observed as different organizations *(Actors)* give cycling lessons to people on how to cycle *(Infrastructure)*, some organizations collaborate with people to raise consciousness about cycling and its benefits and some invite other organizations to learn for the success of the Netherlands. These activities signify *Interaction* among *Actors*. The TIS function of *Creation of Legitimacy* is also present as organizations like the Fietsersbond *(Actors)* are involved in promoting cycling as they are a cyclist union who is always demanding good and safe cycling infrastructure across the Netherlands. *Entrepreneurial Activities* and *Market Formation* can also be seen as many companies *(Actors)* are promoting e-bikes that have several advantages over conventional bikes like a short time for traveling and suitable for the elderly. Moreover, *Mobilization of Resources* and *Guidance of the Search* are also present as organizations *(Actors)* are motivating people in different ways to cycle by giving them incentives of various types *(Institutions)*.

Regarding the interview from Indian experts, bike-sharing programs are increasing indicating that there is an *Interaction* among *Actors* and it leads to *Knowledge Development* and *Entrepreneurial Activities*. Furthermore, the TIS functions of *Guidance of the Search* and *Creation of Legitimacy* can also be observed as cycles are being prioritized for jobs like e-commerce and food delivery *(Actors)* and thereby, trying to merge with the existing scenario for these jobs. *Knowledge Development* and *Knowledge Diffusion* can also be seen as educational institutions *(Actors)* are encouraging people to cycle within their campuses and cars are not being allowed. TIS functions of *Mobilization of*

Resources and *Market Formation* are absent in the Indian context as there are resources are not being appropriately utilized and hence, the formation of a big market is not taking place.

A schematic overview of how the structural dimensions and functions are linked to each other in both countries and what function is present or absent is shown in the figure below. Connecting arrows are given different colours to improve the traceability of the relation between structural dimensions and functions of TIS.

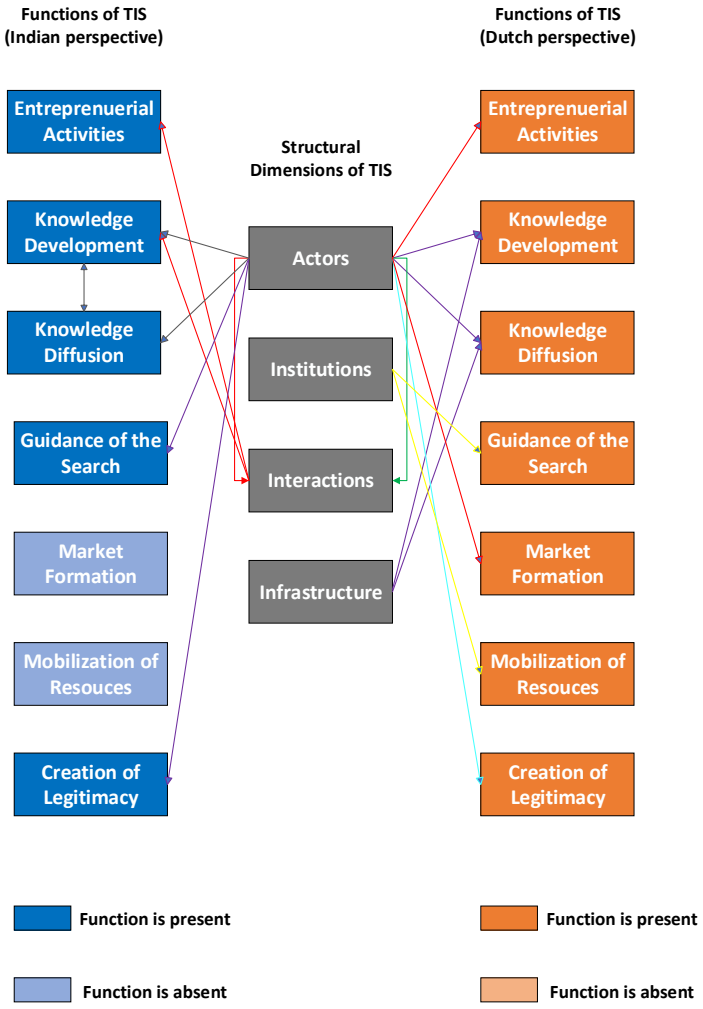

Figure 10: Structural dimensions and functions of TIS regarding the role of firms in cycling adoption

6 Conclusion

This chapter provides the answers to the main research question and all the sub-research questions. Section 6.1 provides an answer to the first sub-research question, section 6.2 provides an answer to the second sub-research question, section 6.3 provides an answer to the third sub-research question and section 6.4 provides an answer to the main research question.

6.1 Sub-research Question 1

The first sub-research question is ***What are the factors for adopting a bicycle as one of the primary modes of transport in the National Capital Region of India?***

Firstly, this study can conclude that there are several factors that are both relevant and common from the Dutch perspective and the Indian perspective. These are infrastructure, safety, social awareness, and multi-modal transport integration. In the majority of Dutch towns, there is plenty of convenient bicycle parking, and for vehicles, there are zones with slower traffic to ensure they are unable to travel above a certain pace and bicycles can ride safely. The Dutch society sees cycling as their daily tool and it is a way of life for most residents. Social status does not matter when it comes to cycling and hence, it is inclusive and for everyone. However, when it comes to the Indian context, the region is poorly developed for cycling. It lacks designated bike paths, the motorized traffic makes the cyclists feel unsafe, there are no parking spaces for cycles, and sometimes, the distance is too large to be covered on only a cycle. Huge sums of funds are invested in building infrastructure for car owners and modal transport integration is not given much importance. People in the Indian capital region need to get aware of the advantages of cycling and start demanding the same from the government. In the 1970s, this was seen in the Netherlands. Concluding about the functions and structural dimensions of TIS that are present or absent in both the countries, it can be seen in figure 8 that there are numerous factors that are missing in the Indian context and the Dutch context has all the functions linked in some manner to the structural dimensions of TIS.

6.2 Sub-research Question 2

The second sub-research question is ***How can the Government of India and other regulatory bodies influence the adoption of cycling in the National Capital Region of India?***

The most important aspects identified with respect to the role of regulatory bodies were political willingness, encouragement of cycling, and collaboration among various stakeholders to improve continuously. An inter-party agreement is essential when designing cycling facilities along with some regional independence that exists in the Netherlands. The country also excels in integrating numerous types of transportation because a variety of actors have worked to make sure that investment in infrastructure and policies regarding cycling work closely together. One of the elements that both the Dutch and Indian experts emphasized was the politicians' willingness. Although the general public is an essential stakeholder, government leadership has had a big impact on the adoption of cycling across the Netherlands by persistently supporting cycling and restraining the desire to plan communities around motorized vehicles. The situation is completely different when it comes to Delhi and its surrounding regions. Politicians understand the benefits of cycling but are reluctant to develop the infrastructure for it as they risk performing poorly in the elections. This is because one of the key development parameters in India is the development of infrastructure for motorized traffic such as expressways and wide highways. When it comes to the structural dimensions and functions of TIS, figure 9 shows that key functions like the Guidance of Search, Mobilization of Resources, and Creation of Legitimacy are absent from the Indian context when compared with the Dutch context.

6.3 Sub-research Question 3

The third sub-research question is ***How can firms contribute to the uptake in cycling adoption in the National Capital Region of India?***

It can be concluded that when it comes to firms, different types of organizations can promote cycling in numerous ways. In the Netherlands, organizations like the Dutch Cycling Embassy do so by collaborating with other organizations in the same field to increase understanding of the benefits of cycling and general awareness of it. The Fietsersbond, a cyclists union in the Netherlands, has also promoted cycling in several ways. Initially, they were the ones who constantly pushed the government to provide safe cycling conditions. Many companies also give allowances to employees who travel to their workplace by bike and some give money to employees if they want to purchase a bike. Some companies are also promoting e-bikes as it is a lucrative business for them and it enables people, especially the elderly, to cover larger distances in a short time which is not possible with conventional bikes. Moving on to the Indian perspective, the bike-sharing systems are starting to pick some steam and there is a huge scope for it in the future. Some institutions have taken inspiration from European countries to promote cycling in their campuses and some NGOs need to promote

cycling by spreading awareness about it. Figure 10 depicts that TIS functions of Market Formation and Mobilization of Resources are missing from the Indian context and the Netherlands consists of all the TIS functions.

6.4 Main Research Question

The main research question is ***What can the National Capital Region of India learn from the Dutch cycling practices with the participation of key stakeholders?***

This research illustrates the factors, barriers, role of the administration, and the role of different firms in cycling adoption in the Netherlands and the National Capital Region of India. It can be concluded that there are several key factors that are responsible for cycling adoption in the two countries. Only a few factors are different between India and the Netherlands.

It can be said that it is crucial for different actors to collaborate with each other in order to bring a change, i.e., transitioning to an environment that promotes cycling. Teaching children about cycling at an early age will enable them to learn about pressing issues like climate change and they will become more mindful of it. As a result, they can learn about cycling and the younger generation will demand to develop safe cycling infrastructure from the decision-makers. The willingness from the administrative side is required to develop favorable conditions for cycling. This includes raising awareness about cycling, its benefits and to portray that it is not only for people who can't afford a car or a motorbike, but it is for everyone. The government also needs to create cycle-promoting policies which encourage people to buy and commute by cycle in their daily life. As far as common people are concerned, they also need to start demanding a good and safe cycling environment from the decision-makers and need to be more conscious of the prospects of cycling. Due to these improvements, businesses will be able to reward their staff as observed in the Netherlands. These elements serve as the catalyst for change and provide the necessary guidance for the stakeholders to carry out this change.

Technological Innovation Systems (TIS) was selected as the theoretical framework for the research. The structural dimensions and functions of TIS have been discussed for all the sub-research questions along with the comparison of the Dutch and Indian perspectives in sections 5.1.3, 5.2.3 and 5.3.3. To summarise, it was concluded that for the factors, the impact of regulatory bodies and the role of firms affecting cycling adoption, the Netherlands fulfills all the functions of TIS while the Indian context does not consist of several TIS functions and they are different for each sub-research question.

7 Discussion

This chapter discusses the relevance of research in sections 7.1, 7.2, and 7.3. The limitations of the research are discussed in section 7.4, the recommendations for the future are presented in section 7.5, and the relation of the thesis to the Management of Technology Study Program is discussed in section 7.6.

7.1 Practical Relevance

The practical relevance of the research is that it provides key factors from the viewpoint of different stakeholders regarding the choice of transport in India and the Netherlands. It compares the findings from the expert interviews that elaborates on different and relevant facets regarding cycling adoption in both countries. To bring new knowledge that policy-makers can use to increase cycling adoption in the National Capital Region of India, the Netherlands was chosen for a comparative study as the country is regarded highly for cyclists and mobility. Furthermore, as discussed in section 1.2, the problems faced by Delhi and its surrounding areas are the same problems that the Netherlands was facing in the 1970s. Therefore, it is of practical relevance that a comparison is selected in such a way that it resonates with the main entity being studied, that is, the Indian capital region.

As elucidated in section 2.1.3 by Nello-Deakin and Nikolaeva (2021) and Haustein, Koglin, et al. (2020), hard and soft factors are discussed in detail in the findings as the focus cannot only be on hard factors due to social and cultural norms. Chapter 4 is also significant for the research as it highlights how car-dominated cities can become the best cities for cycling in the world and what Delhi can learn from them. In this chapter, section 4.2.3 provides important insights into the degree of cyclist satisfaction and this has been included as safety is a huge concern among people who cycle or want to cycle in the National Capital region of India. The technological Innovation Systems (TIS) Framework provides a clear overview of the findings and the present situation in the National Capital Region of India regarding cycling adoption. The comparison in figures 8, 9 and 10 between India and the Netherlands regarding the structural dimensions and functions of TIS highlights where the Indian capital region lacks when compared to the Netherlands. The TIS also shows how relevant stakeholders need to collaborate and interact with each other in order to promote cycling as seen in the Dutch context. Hence, the relevance of the research lies in the practicality and applicability of the findings by learning from the best.

7.2 Theoretical Relevance

The theoretical relevance of the research is that it provides a direction for relevant stakeholders in India to analyze the findings related to the structural dimensions and functions of the Technological Innovation Systems (TIS) Framework in sections 5.1.3, 5.2.3 and 5.3.3. It can be observed that there are several pertinent aspects that are missing from the Indian context. Entrepreneurial Activities are required for bicycle adoption because they bridge the gap between the market and the end user. That is, creating a market in which cycles are affordable to a larger population. In the scope of the research, Knowledge Development and Knowledge Diffusion refer to the formation of new knowledge that is important for multiple stakeholders in order to attain high cycling rates. For example, expertise is required to create bicycle networks such as those observed in the Netherlands. To accomplish this, the government must invest in urban planning and hire qualified individuals to provide meaningful knowledge. Furthermore, these networks must be available to people of all socioeconomic backgrounds. This also includes raising awareness among people about cycling as a viable option for daily transportation, regardless of money. Knowledge can be disseminated in novel ways to reach people of all backgrounds, encouraging them to cycle instead of using automobiles. The Guidance of the Search indicates that the government must exercise caution when allocating its limited funds to the construction of secure bicycle infrastructure. The regulatory organizations also need to give cycling more attention and make it easier for consumers to purchase, access, and maintain a bicycle. People may receive tax incentives, for instance, when purchasing a new bicycle. Such advantages are provided to the people in the Netherlands, which is one of the causes of the country's high cycling rates. Market Formation outlines the improvements that are required to be done in the existing market for cycling in order to increase cycling adoption and adapt to it in the future. While doing so, various aspects will be discovered that might be specific to the Indian capital region which can lead to a more requisite formation of market. The function of Mobilization of Resources points out that a significant amount of funds are required in order to build a safe and inclusive infrastructure for cycling. Furthermore, to comprehend the Indian capital region and its needs, in-depth research is necessary. The Creation of Legitimacy function indicates that to make it pleasant for people to transfer from automobiles to cycles for their mobility, the Indian government must develop rules, regulations, and policies that integrate appropriately with present ones. To conclude, the research offers a course of action through TIS by examining the key components required to be attained.

7.3 Societal Relevance

The societal relevance of the research is that the government's function and the effects of high cycling rates on the populace are discussed in the Dutch context. This explains how a nation that was formerly dominated by cars changed to become a cycling-friendly country. It highlights the fact that both the people and the government play crucial roles in bringing about change that the nation may use to its advantage. The Case of Amsterdam and Copenhagen examines the past and present of these cities to explain the social attitude of residents and decision-makers that assisted them in becoming places that are currently recognized as among the finest for cycling. For cycling in India and its capital region, the mentality of people, the outlook of the government, and the consequences of such a mindset are discussed to highlight the need for change. Social acceptability was one of the primary differences between India and the Netherlands. It is noted that all socioeconomic groups ride bicycles in the Netherlands, whereas only those who cannot afford cars ride bicycles in India. In India, bicycles are also not given much attention on the road and are occasionally seen as an obstruction by motorists. All of this is connected to societal perceptions and general public knowledge of cycling. The study explains how societies may evolve and what steps individuals and governments can take to bring about a larger-scale transition.

7.3.1 Reflection on Generalizability to Other Regions

The relevance of the findings to other parts of the world is covered in this section. The findings may be applicable to regions with traits comparable to those of the Indian capital region. The relevant factors that should be considered include land area, population, the modal share of various modes of transportation, and the attitude of the general population toward cycling. Some of the regions which have similar characteristics to the Indian capital region are the metropolises in South East Asia, Africa, and South America. The conclusion of the research can serve as a starting point for governments and residents to promote cycling more widely and to bring about a larger transformation that will benefit the nation and its transportation systems.

7.4 Shortcomings of the Research

With the goal to increase the level of accuracy, researchers should be transparent and provide full disclosure of their study constraints, boundaries, and assumptions. On the other hand, the reputation of research suffers if any of these crucial components is omitted or disregarded (Theofanidis & Fountouki, 2018). This study dealt with a num-

ber of limitations. Only the most significant elements that affect the choice of transportation were discovered due to the research scope and time constraints. Only expert interviews were conducted, but interviews with individuals interested in cycling in the Indian capital region would have provided a different viewpoint and the data saturation point would have been prolonged. Regarding the Technological Innovation Systems (TIS), the theoretical framework of the research, there are a few shortcomings. As pointed out in section 2.2.1, there are more stages of TIS other than the Classification of Structural Dimensions and Modeling the Functional Mechanisms. But, only these two stages are selected and it can be argued that other stages might also have been suitable for the research. Furthermore, when comparing the TIS functions and structural dimensions, it can be seen what is present and absent in the Dutch and Indian context. However, this indication is only from the perspective of experts and not common people who might have different viewpoints and new insights could have been gained from it.

7.5 Recommendations for Future

To enhance the knowledge gathered from this study, a number of other research subjects are suggested. Firstly, by studying the factors from this study, a systematic procedure can be developed for the Indian capital region on how to increase cycling adoption and what are important components missing in the present situation. Secondly, studies can be conducted which include experts as well as common people so that different viewpoints are discovered and a more holistic perspective can be achieved. Thirdly, different frameworks can be used to investigate the topic that provides a more India-focused conclusion. Furthermore, a developing country or a city that has recently seen an increase in cycling adoption can be compared to the Indian capital region rather than a developed country as it can help the stakeholders in India to gain an understanding of the new changes and requirements of people and take action with limited resources. As for the practical recommendations, schools in India can start educating children about the benefits of non-motorized forms of transport and how it helps in fighting climate change. Promotional initiatives like Cycles for Change and car-free days need to happen at a large scale and case studies of European success stories can be used to portray changes and benefits of higher cycling adoption. Government can campaign to spread awareness about the merits of cycling and how motorized vehicles are causing harm to the environment. Moreover, the administration needs to think of innovative ways to portray that cycling is for everyone and not only for the poor. The government also needs to give incentives to people who choose to buy cycles instead of taxing them and create a supportive environment so that more

people can be encouraged to adopt cycling as one of their primary modes of transport. Incremental upgradation to enhance safe cycling infrastructure is required from the administrative side and the same was observed in the Netherlands.

7.6 Link to Management of Technology (MoT) Study Program

The Management of Technology (MoT) curriculum teaches to investigate and comprehend innovation like a resource that makes it possible for a business to juggle a variety of tasks. It also involves learning complex issues like at what point in time, a particular technology is required, and how should we get access to the innovation or technology, among other aspects (TUDelft, 2023). The topic of the thesis is linked to the MoT study program as the adoption of technology and the factors for adoption from the viewpoint of relevant stakeholders are discussed in detail. Also, the role of different firms and regulatory bodies is discussed from different viewpoints like social, economic, and technical. Moreover, the thesis also linked the findings from the interviews and literature to the Technological Innovation Systems (TIS) Framework and compared the TIS between the Indian and Dutch perspectives. These concepts were also taught in some of the courses of the MoT study program, namely, Technology, Strategy and Entrepreneurship, Emerging and Breakthrough Technologies, and Technology Dynamics.

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Appendix A

Interview Summary

This section contains the summary of all the interviews conducted for the purpose of the research. The names containing **NL** are respondents from the Netherlands and the names containing **IND** are respondents from India. This naming scheme is chosen for clearer comprehension to the reader and to preserve the identity of the respondents.

NL-1

The respondent is a Researcher in the field of Urban Mobility and has lived in the Netherlands. The interview started with the introduction of both the people and how did I find him for the research. Then, the interview commenced. Regarding the soft and hard factors that affect the choice of people to cycle in the Netherlands, the respondent pointed out good infrastructure, and at the same time gave an example of The United States of America's city layout. It was mentioned that the cities in the USA are far bigger. The respondent also mentioned shorter distances and ease of access in the Netherlands and said that it is easy and cheap to get a bike and travel with it. Also among the soft factors, it was mentioned that people are fine with leaving their bikes on the side street for some time and nobody really cares about it, although begin illegal. Key stakeholders were also identified by the respondent and they were people, and municipalities. He mentioned that cycling policies are decided on a municipal level. Although decisions related to cycling are mostly taken at Municipal levels, there is a Dutch standard for cycling. It was also mentioned that some people are against rules like forbidding the use of phones while biking. The argument is that if listening to music is allowed in the car, then why not on the bike. Regarding the shift from the car-promoting model to a bike-promoting model, it was pointed out that many people were killed in the 1970s and then people started to protest, especially in Amsterdam, and the government listened. This brings us to another important factor, which is, political will. It is vital for the stakeholders to collaborate and the decision makers should imply these policies. When asked about the role of the firms, it was mentioned the promotion of e-bikes. This brings another factor that is crucial for people to cycle in the Netherlands and this is safety. When asked about the future of cycling in the Netherlands, it was again pointed out that it is important to have the political will for the successful promotion and adoption of cycling. The interview ended with the interviewee pointing out car minimization strategies undertaken by municipalities which in turn promote cycling.

NL-2

The respondent is a Mobility Expert specializing in cycling and walking and is living in the Netherlands. The interview started with the introduction of both the people and all activities the respondent participates related to cycling. Concerning the soft factors that influence the choice of transport in the Netherlands, early learning, practicality, and shorter distances are the factors that were pointed out initially. The respondent pointed out that in the neighborhood where he/she lives, there are many people with no cars as most of the things are accessible by bike, public transport, or a combination of both. The interviewee pointed out that children learn to bike at a very early age and parents teach them the know-how of cycling. Infrastructure and cycle-friendly rules and regulations are some of the hard factors that were identified as vital for high cycling rates by the respondent. It was also mentioned that buying a car is expensive and the parking cost is also expensive in some cities like Amsterdam. Hence, car minimization was also identified as a factor for people to cycle in the Netherlands. A combination of stakeholders was pointed out by the respondent when asked to identify the key stakeholders responsible for high cycling rates. The political will of the administration is crucial to implement such cycle-friendly policies along with the people who act at a local level like mayors and city councils. Common people were also identified as important stakeholders as they are the ones who vote for the administration. When asked about the role of the regulatory bodies, it was pointed out that rules like the maximum speed limit for cars in the city are a good way to promote safety for cyclists. It was also emphasized that many cities in the Netherlands build infrastructure for cycling from the money collected from high parking fees and fines. Lastly, it was mentioned that roads and highways around some cities are built in such a way that they minimize car traffic within the city limits.

NL-3

The interviewee is an expert in cycling, especially in Utrecht, and also films cycling videos on a regular basis. The interview started with the introduction of the participant and then the researcher. The respondent highlighted the reason for making videos related to cycling. The interviewee mentioned that he/she learned cycling at the age of 4 and that he/she still has the first cycle. Early learning and safe cycle infrastructure were important factors that were key to learning cycling at such a young age. The respondent also mentioned that there are some schools that give cycling and road safety lessons and children have to give a practical exam as well. It was pointed out that most car drivers are cyclists themselves so it helps in enhancing the safety of

cyclists. A healthy lifestyle was a vital soft factor that the respondent focused on. Also, ease of access was highlighted as cycles are widely available and maintenance costs are low as compared to motorized vehicles. People, local and national governments, and bodies like the cyclist union (Fietsersbond) were identified as major stakeholders in the adoption of cycling. Furthermore, it was mentioned that the people of the Netherlands are healthy and that is partially due to high cycling rates. Car minimization strategies were also pointed out like making car parking expensive and using that money to improve cycling infrastructure. When asked about the integration of new rules with the existing ones, the respondent mentioned that it is not regulated and gave an example of electric mopeds which are running on cycling paths and are not allowed to do so, but no one is regulating it. Research organizations were identified as important firms along with institutions that provide training for cycling. Cyclist Union was also identified as a key private player as they promote cycling across and beyond the country. When asked about the impact of regulatory bodies, the interviewee mentioned that the national and local governments are mostly in favor of cycling and that the Netherlands were lucky because the government listened to the people when they protested in the 1970s. The interview ended with a question about the future of cycling in the Netherlands and the respondent mentioned that it is on track to increase awareness related to the benefits of cycling is increasing among key stakeholders.

NL-4

The respondent is the Marketing and Communication Manager at a cycling organization in the Netherlands. The interview started with the introduction of the interviewer and interviewee. The respondent mentioned that cycling in the Netherlands for an Individual starts at a young age and children are taught how to use the infrastructure appropriately. There is also a curriculum in school on traffic safety and how to walk and cycle safely. When asked about factors, the respondent pointed out that it is not just building cycling lanes, but developing a network of grids of origins and destinations to make sure it is easy to cycle from one point to another. Traffic calming and traffic circulation are also an important part of the Dutch cycling infrastructure as it makes the cyclists feel safer. The integration between cycling and public transport is also a vital ingredient in making cycling desirable. The participant emphasized that generally, municipalities are responsible to develop and maintain the cycling networks and take care of factors like awareness and encouragement. Also, it is the national government that has the will to promote cycling across the country and they provide standards for the municipalities to follow and implement. The Netherlands has also invested heavily in bike parking and one example that was provided is the newly opened bike

parking near Amsterdam Central Station which is underwater. It was highlighted by the respondent that it has taken almost 5 decades for the Netherlands to make cycling so desirable, and people today are benefitting from it immensely. It was also added that only 3% of the total transportation budget is spent on cycling in the Netherlands and still it makes a huge difference. The Dutch government sees this as an investment and not as an expense as it has numerous economical benefits in the future. It was put forward that there is a manual for design standards that every Dutch city has to follow, and this is the reason why most of the cities look similar in the Netherlands. When asked about firms, the respondent mentioned that it is mostly the government that has taken the lead and the firms are just benefitting from a higher cycling adoption. When asked about the future of cycling in the Netherlands, the respondent mentioned that 30 km/h neighborhoods will increase along with the rise of E-bikes as they help the elderly and can cover larger trips in a short time.

NL-5

The respondent is an Urban Developer in the Netherlands whose focus is cycling. The interview started with the introduction of the interviewer and interviewee. The respondent mentioned that the reason that biking is so common in the Netherlands is because it is cheap and easily accessible along with being healthy. It was also pointed out that circulation plans for car traffic have also been made in the last 2 or 3 decades to reduce car traffic from the centers of the cities and make it safer for cyclists. Children in school are taught the know-how of cycling and it gives them independence at a young age to travel from point A to point B. Cycling is a social norm and it is for everyone. The participant highlighted that the energy crises and pollution were important reasons that the people of the Netherlands demanded a cycling-centric environment and luckily, the administration listened to them. The cyclists union and some other organizations have been very vocal about the promotion of cycling and they have got good support for it. When asked about stakeholder collaboration, the respondent emphasized that it is crucial to collaborate, and it has been done well in the Netherlands. It was also pointed out that the government has invested in building highways for cars, but this benefits the cyclists as well due to car traffic diversion from the center. When asked about the improvements, it was added that it is becoming increasingly difficult for the administration to improve the cycling network as it is already very good and the administration needs a strong reason to improve infrastructure at a specific place. Regarding the role of firms, the interviewee mentioned that companies are giving tax incentives, and changing room facilities among other things that promote employees to travel by bike to their workplaces. Lastly, it was added that the Netherlands has a

habit of experimentation and this has resulted in developing an efficient, integrated, and safe mobility network.

NL-6

The respondent is a Researcher in the field of inclusive mobility. The interview commenced with the introduction of the interviewer and interviewee. When asked about the factors that motivate people to cycle in the Netherlands, the respondent mentioned that people have demanded good cycling infrastructure because they want to cycle and hence the government listened to them. The short distances are very important for cycling adoption on a larger scale as it becomes practical and easy. It was highlighted that the environment for cyclists is safe since many people cycle leading to desirable surroundings for cyclists. The respondent also mentioned that cycling has been made a useful form of transportation and is an attractive option with regard to cost and time. The respondent also argued that some cycling infrastructure is developed so that car movement can be streamlined and gave an example of the Hovenring near Eindhoven. It was also emphasized by the participant that the government develops cycling infrastructure because they have to do something for all the people who cycle as they can't be left out. When asked about the role of the regulatory bodies, it was pointed out that there are some cycle-friendly rules and regulations like it is the responsibility of the car driver if an accident happens with the cyclists unless proven otherwise and cyclists are given priority on the roundabouts among other advantages. When asked about stakeholder engagement, it was mentioned that the national government and the municipalities work in cohesion to encourage cycling. When discussing E-bikes, it was mentioned that they require more secure parking as they are much more expensive than conventional bikes. This factor is one that makes Dutch cycling successful, i.e., cheap and easy availability of bikes which is not the case with E-bikes. The interview ended with the respondent pointing out that the cycling habits of children might be at risk as parenting styles are changing and they want to drop their kids to school with cars as they are safer.

NL-7

The respondent is a Lecturer and Cycling Infrastructure Planner. The interview commenced with the introduction of the interviewer and interviewee. The respondent mentioned that parents teach children how to cycle and schools only test their cycling skills. When asked about the hard factors, the respondent mentioned that it is the cohesiveness of the network and its ability to take cyclists anywhere. It is vital that

the cycling networks extend beyond urban areas which has resulted in people living in rural areas are use cycles in their daily lives. People in the Netherlands have realized that they can have a good life without a car as cycling and its integration with public transport is very good. The flat terrain and smaller cities also contribute to the cycling rates. Cycling is rooted in Dutch culture and it is made to take people faster within the cities as compared to cars. Historically, activists have played an important role to promote cycling and now the decision-making has become institutionalized. The Dutch spend a lot of money on infrastructure that is safe for cycling and walking. The respondent mentioned that E-bikes are popular, but have not affected the cycling adoption rate significantly. The regulatory bodies have experimented at a local level to make cycling safe and have found success in it. The Dutch provinces have a lot of autonomy to make decisions and develop infrastructure and, at the same, they have to follow some standards set by the national government. Cycling has incrementally improved in the Netherlands which has resulted in the country having the highest adoption rate in the world.

IND-1

The respondent is a Researcher and Urbanist. The interview started with the introduction of the interviewer and interviewee. The respondent mentioned that the Indian capital region lacks a dedicated infrastructure for cycling and the traffic has a mix of cars, motorbikes, carriages, and rickshaws which make cycling unsafe and unattractive. Even with appropriate safety gear, cycling is not safe due to poor infrastructure and car-encouraging policies. When asked about the soft factors, it was mentioned that owning a car is a status symbol in the country and slowly, things are changing for the good in New Delhi and its surroundings. Also, the weather was pointed out as a demotivating factor for people to cycle as it is hot for the most part of the year in the region and people choose the comfort of a car that has an option of air conditioning rather than going on a bicycle. During the rainy season, roads get clogged with water and cycling is not possible in that weather as well. Furthermore, there are no parking spaces for cycles, so people who cycle have no choice but to park their cycles at a random or unsafe place. When asked about transport integration, it was highlighted that several European cities have a dedicated system of taking bicycles in the trains and metros while New Delhi lacks it despite having a good metro network and system. When asked about the role of the administration, it was mentioned that campaigning is required to show bicycles as a viable mode of transportation and small patches of networks should be created in order to test and experiment and then build on it. A set of guidelines and policies are also required from regulatory bodies for the

infrastructure to be put in place for cycling. Several people have started using self-pay bike-sharing systems which can be found near busy metro stations and this is a good starting point in cycling adoption as it provides last-mile connectivity to people. It was pointed out that middle-class people cycle in India for leisure and not for daily purposes and this needs to change. The interview concluded with some feedback and a discussion about the scope of the thesis.

IND-2

The respondent is a Technical Advisor in the field of sustainable urban mobility. The interview started with the introduction of the interviewer and interviewee. Accessibility, affordability, and economic groups were among the factors that were identified by the respondents that influence the choice of transportation. It was highlighted that car ridership is encouraged as India has a booming automobile industry and it is comfortable and affordable as well. The priority for the government has not been to develop infrastructure that promotes cycling and walking and hence there is low adoption of non-motorized forms of transport. Political commitment is lacking in India and the respondent also highlighted that there is a lack of awareness among people and the administration regarding the benefits of cycling. It was stressed that the main factor for the adoption of cycling to increase is political will. Building roads and highways is considered an important development parameter in India and hence, decision-makers are keen on developing infrastructure that caters to car drivers and not cyclists. Another crucial aspect pointed out was the focus on space allocation as cars take up a lot of space when compared to public transportation or cycles that results in air pollution. The decision-making is politically driven and far from ground reality. When asked about the promotion of cycling, it was mentioned that there are several educational institutes that do not allow cars on their campus and that people either have to walk or cycle to travel within the campus. It was also put forward that the education system should focus on climate change and the need to embrace non-motorized use of transport so that the voters of the future choose their representatives based on these issues. The interview ended with the interviewee discussing the future of cycling in the region and mentioning that it does not look promising.

IND-3

The respondent is a Project Lead-Climate Center for Cities. The interview started with the introduction of the interviewer and interviewee. Regarding the infrastructure, the respondent mentioned that south and central Delhi has better infrastructure for cy-

cling as compared to other parts. More greener areas are also required in the region as they can provide relief and shade to people who are walking or cycling and can result in improved air quality. It was put forward that Delhi has one of the highest car ownership in the country and people are not comfortable driving cars due to traffic jams. Moreover, the administration lacks when it comes to maintaining the infrastructure and it gets dilapidated over time. The respondent mentions that the administration is also not sure how much uptake in cycling will happen even if the infrastructure is developed. Environmental conditions also play a role in the choice of transport people take. The Ministry of Housing and Urban Affairs and the Ministry of Health has done some promotional activities to ensure people remain fit and healthy. E-bikes and bike-sharing programs are also on the rise in the region which is making bikes easily accessible to people without taking ownership of it. The interview ended with the respondent predicting that the future seems to be more geared towards e-bikes.

IND-4

The respondent is a Deputy Manager-Inclusive Compact Cities. The interview started with the introduction of the interviewer and interviewee. When asked about the hard factors, the respondent pointed out that firstly, it is important to identify the users as the Indian capital region has people from varied economic groups. Road safety is concerning when it comes to cycle and it was highlighted that there are many people who cycle for recreation but do not for daily transit as it is difficult to navigate during peak hours due to car traffic. Also, parking spaces for cycles are absent and people who want to cycle for completing daily chores are demotivated to do so as they don't know where to park their cycles. It was also put forward by the respondent that a survey was done through a program called India Cycles for Change Challenge and it was found that weather is not a big hindering factor when it comes to the choice of transport. When it comes to the soft factors, transiting in a motorized vehicle is a matter of aspiration in India, and people who can afford to buy a car travel in a car rather than a cycle. When it comes to spending on infrastructure, the government has invested in developing wide roads that are catered to cars and bridges that enable automobiles for uninterrupted travel. Users of non-motorized modes of transport are neglected or not taken seriously. The National Capital Region of India does not have a dedicated transport authority that controls all forms of public transport like Singapore or London and it is required for better and more efficient integration of transportation. Politicians understand the benefits of cycling but they have not taken any bold steps as it might risk their political career because road infrastructure development is an important indicator in the eyes of common people in India. It was highlighted by the

respondent that the Delhi Government has launched a program for Delhi's street to make it more suitable and attractive for walking and cycling. The Indian Smart Cities initiatives also talk about the need for cycling policies for its promotion. The interview ended with the respondent mentioning that it is up to the government to show the will to promote cycling by investing in it.

IND-5

The respondent is an Urban Designer. The interview started with the introduction of the interviewer and interviewee. Weather along with longer distances were pointed out as crucial hard factors when it comes to selecting transportation in Delhi. The distances are too long to be covered on a cycle and hot weather for most of the year makes it even more uncomfortable. However, there are still many people who cycle on a daily basis as they cannot afford to buy a motorized vehicle. The majority are traveling in a safer mode of transport so they are not very considerate of the people who cycle or walk and this makes cycling and walking unsafe and dangerous. When discussing transport integration, the respondent gave an example of Ghaziabad, part of The National Capital Region, which has metro stations that are not connected appropriately to most of its residents and this also needs to improve. There are people who cycle as it has health benefits and this trend is on the rise. When asked about the barriers, it was put forward that implementation and maintenance are challenging, and designing a policy is not the main challenge, it is acting on the ground. When asked about the cycling adoption trend, it was mentioned that it is increasing but is only limited to people who use it for leisure purposes or for health benefits and not for daily commuting. The interview concluded with the respondent pointing out that in the future, people have to look beyond the comfort of cars if cycling adoption has to be increased.

IND-6

The respondent is a Senior Associate-Sustainable Transport. The interview started with the introduction of the interviewer and interviewee. The interviewee highlighted that a survey was conducted by a transport organization which showed that almost 90% of the people are ready to cycle and walk if the requisite infrastructure is provided. Environmental conditions, fast-moving vehicles, and gender discrimination are some of the issues pointed out when it comes to selecting a transport. People who can afford other modes of transportation only cycle for recreation and the administration needs to campaign in the right manner to shift this perception that cycling is

only for the poor. It is vital that the campaign reaches the right people so that they can be empowered. It was also put forward that any developed country in the world has good road infrastructure including the Netherlands, but it is about making sure people reach their destination in the most efficient, economical, and sustainable way. It was emphasized that collaboration among different levels of government is also important, for example, the municipality making sure to implement the right practices for cycling and walking. A specific set of guidelines are required along with appropriate financing to develop infrastructure that is safe for cyclists. When asked about other hurdles, it was mentioned that there is a lack of awareness among the administration regarding the budget and the right people needed to tackle these issues. It was highlighted that cycling infrastructure also involves building footpaths and healthy streets altogether. When talking about the role of firms, bike-sharing services were pointed out and it was mentioned that there is a lack of funding and till now, it has not been a viable business model as the prices are extremely low to attract users.

IND-7

The respondent is a Bicycle Mayor. The interview started with the introduction of the interviewer and interviewee. Discussing the factors that influence the choice of transport, social status was emphasized upon. Even among the people who cycle, those who can afford an expensive cycle choose that irrespective of the utility just to differentiate from others and poor people who cannot afford a fancy cycle. It was mentioned that Indian cities make cycling look unattractive for the sake of promoting cars. The respondent emphasized that people complain about air pollution and high traffic, but at the same time, it is these same people who are responsible for increased traffic on roads and air pollution resulting in unhealthy surroundings. Awareness among car drivers is also required as many in the Indian capital drive in a rash manner making pedestrians and cyclists feel unsafe. Furthermore, there is an urgent need to make the region more greener to combat the effect of heat and increase shaded areas. When asked about the barriers faced by the government, it was mentioned that there are no big barriers for the government and the factor that is lacking is the political will among decision-makers. Only the lobbying in the automobile sector was pointed out as a significant barrier and that also related to the administration. When asked about the role of different firms, the bike-sharing system was discussed but it was mentioned that it will not grow significantly until and unless there is infrastructure to complement it. The interview ended with the respondent pointing out that at one point people will get fed up because of high traffic and they will start to realize that a shift to cycling is necessary.