



Role of Dedicated Walkways and Cycleways

EcoMobility: An Integral Part of the Next Generation Transport Systems in Asia



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Foreword

Urban mobility is a crucial part in facing the environmental battle and the social struggle that our cities face. The path that our mayors and decision makers choose today will reflect how our cities and transport systems are formed in the future for our forthcoming generations. Choosing better mobility options that cater for the needs of the majority rather than the wants of a selected few will not only bring our cities out of a future that currently seems to be congested, filled with polluted air, lacks places for us and our children to spend leisure time into a future that has cleaner, greener and economically beneficial mobility options.

A smart future for a city is one where every citizen benefits from the choices the smart leaders make rather than bear the brunt of the choices that favour a few.

I sincerely hope that this publication of ICLEI and UNCRD will provide valuable input to various decision makers in our cities in creating walkable and bikeable neighbourhoods and communities.



Gino Van Begin
Secretary General
ICLEI - Local Governments for Sustainability

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Introduction

Our cities in Asia are urbanising at a very fast pace. Though the change in economic lifestyles in our cities can be seen as a positive indication, there are various disbenefits from the choices our cities make especially in the urban mobility sector.

Cities continue to perceive motorisation as an upgrade to the current quality of life, this can be seen in the amount of investment in automobile friendly infrastructure. We build fly-overs, expand roads and provide various free services for automobile users esp. cars and motorcycles. The consequences of these decisions are shadowed by the increase in automobile use which is considered a positive indicator of development. This “predict-and-provide” fashion of supporting motorisation puts cities into a vicious cycle of transportation (figure 1).

Around 120,000 people are added every day to cities in Asia. Our cities in East Asia will absorb 500 million new residents by 2025. In South Asia around 400 million residents live on less than a dollar a day. In addition to these urbanisation challenges, our cities are also faced with social, environmental and economic challenges due to rapid motorisation. In addition to the temporary benefits, motorisation brings to our cities various disbenefits.

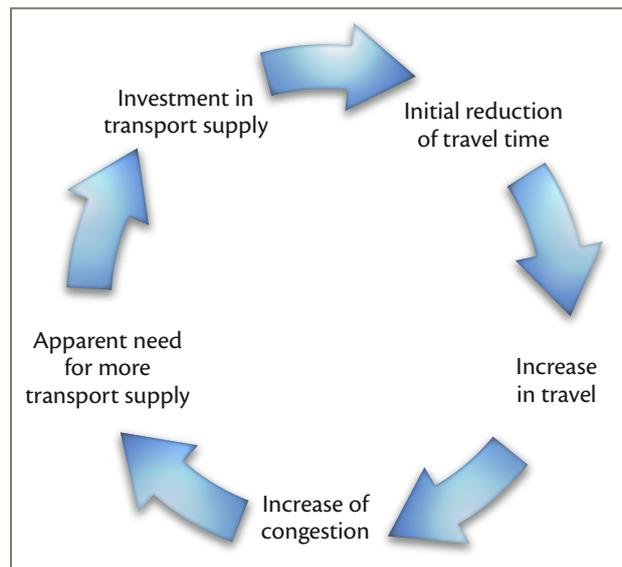


Figure 1: Vicious cycle of urban transport

Road congestion in Asia costs around 2-5% of GDP every year (ADB, 2010). Though there is no estimate on the amount of land lost to automobile facilities such as free parking, it can be easily guessed that it is not cheap.

The environmental and social costs of increased motorisation come in the form of increase air pollution, excessive use of fossil fuels, increased green house gas emissions, road accidents, deterioration of public health especially in the form of sedentary lifestyles and increase in obesity.

On the brighter side, there is a way out and the choice to change the future is in the hands of our decision makers. Several cities in the western world e.g. Copenhagen, Amsterdam, Munster, Freiburg etc. were also in a similar situation and have successfully abated the negative outcomes of motorisation through better mobility choices and importantly by prioritising walking, cycling and public transport - the sustainable transport modes.

Sustainable mobility and EcoMobility¹ suggest that cities need to shift their focus from investing in facilities for motorised modes i.e. personal cars and motorbikes that only cater for the needs of a small part of the population, to modes that cater for a major of the population i.e. public transport, walking and cycling.

In practical terms this transition can be summarised through the **Avoid, Shift, Improve and Integrate** principle.

The **Avoid** suggests that cities need to implement policies and measure that reduce and/or avoid the need for unnecessary trip or short trip by motorised modes. This is done mainly through efficient urban planning.

The **Shift** suggests to move trips from personal automobiles to non-motorised modes i.e. walking, cycling and public transportation, thus targeting the issues such as road safety, air pollution and road congestion.

¹ EcoMobility is travel through integrated, socially inclusive, and environmentally-friendly transport options, including and integrating walking, cycling, wheeling, and use of public/mass transport.

The **Improve** suggests retrofitting and investing in intelligent systems for better efficiency, this could be in the form of better fuel economy, intelligent transport systems for better information delivery, better vehicle technologies and shifting to smarter and cleaner energy for vehicles.

Finally, **Integrate** refers to a collective approach in addressing urban transport issues through integrating different modes of transport available in the city in terms of infrastructure, institutions and ticketing. By implementing policies and measures supporting the *Avoid, Shift, Improve and Integrate* toolbox cities can effectively address urban mobility issues.

The current paper focus is given on promoting walking and cycling in Asian cities. The reason behind this is many Asian cities already possess the characteristics to encourage walking and cycling i.e. mixed-land use and density. These cities also have a large number of bicycle users and pedestrians (table 1)(EMBARQ, 2011). Thus, the effort required to promote walking and cycling is lesser compared to cities that have very less walking and cycling numbers including many developed cities in the west.

Table 1: Study by EMBARQ in 12 Indian cities

Source: <http://www.embarq.org/sites/default/files/India-Integrated-Transport-Indicators-EMBARQ.pdf>

City	Modal Split for Travel, Percent of Trips					Vehicle Ownership	
	Population (2001 Census)	Public Transport	Private Transport	Bicycling & Walking	Average Trip Length km	Vehicles Per 1000	Passenger Cars Per 1000
Ahmedabad	4,500,000	30	38	32	5.4	371	55
Bangalore	8,625,000	36	39	25	9.6	283	50
Bhopal	1,433,000	28	19	53	3.1	189	24
Chennai	7,014,000	39	30	31	8.6	226	45
Delhi	13,840,000	48	19	33	10.2	355	117
Indore	1,759,000	16	37	47	5.6	257	27
Jaipur	2,032,000	17	39	44	5.4	359	55
Mumbai	17,702,000	52	15	33	11.9	54	24
Mysore	787,000	26	23	51	2.5	380	40
Pune	4,200,000	12	54	33	6.1	335	48
Rajkot	1,002,000	13	38	49	3.7	403	33
Surat	2,430,000	13	31	55	5.3	492	55

City	Modal Split for Travel, Percent of Trips					Vehicle Ownership	
	Population (2001 Census)	Public Transport	Private Transport	Bicycling & Walking	Average Trip Length km	Vehicles Per 1000	Passenger Cars Per 1000
London	6,679,699	40	45	14	7.5	356	288
Paris	10,661,937	54	18	28	8.3	383	338
New York	18,409,019	54	35	11	16.7	459	412

The options mentioned in this document ensure that walking and cycling in cities are made secure, attractive and a viable alternative to the use of personal automobiles. It has to be noted that to amplify the results of the measures suggested in this document, cities will need to approach urban mobility in an integrated approach.

The Non-Motorists

Due to the prime focus on motorisation we steered away from the importance of walking and cycling, some may call this development and it is a development with various negative consequences. In many cities walking and cycling – collectively known as Non-Motorised Transport (NMT) – is perceived as inferior modes of transport as it is mainly the poor who are often seen walking and cycling.

The lack of available infrastructure and priority for NMT deters people from walking and cycling, which reduces the modal share² for these modes. On the other hand, the reduction in walking and cycling is perceived by decision makers as people being disinterested in these modes and less or no effort is made favouring NMT. This trend unknowingly forms a vicious cycle (Figure 2).

As a consequence, the non-motorists who are able to afford a personal motor vehicle shift to the motorised modes and join the increasing vehicle owners and add to the ever increasing congestion in a city. This makes the decision makers perception a *self-fulfilling prophecy*³ (Aronson, Wilson, Akert, 2013⁴).

We seldom recognise that our cities are filled with pedestrians, cyclists and potential cyclists. Almost all of our citizens are pedestrians at one point of their journey, be it walking to the bus/train station, walking in a shopping district, or car users walking to their parked car. As mentioned earlier several Asian cities also have a, rarely reported, high cycling share and potential cycling interest contingent on various factors.

With more than 400 million living below poverty line, in South Asia alone, promoting cycling and walking seems to be a better option not only for socio-economic reasons but also due to the various benefits linked to cycling and walking.

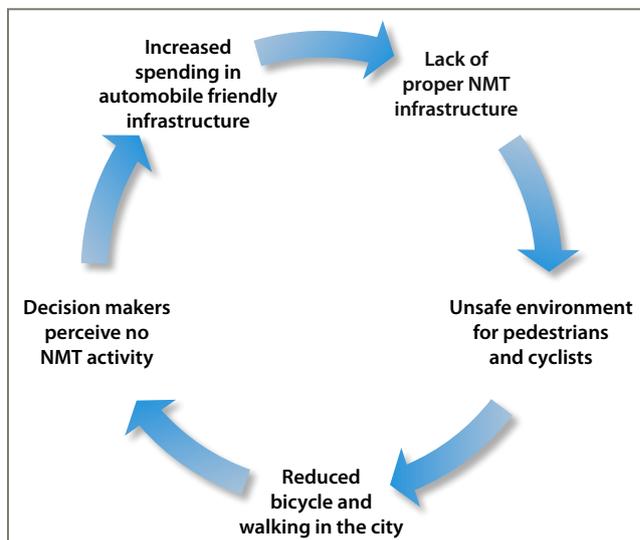


Figure 2: Vicious cycle in Non-Motorised Transport

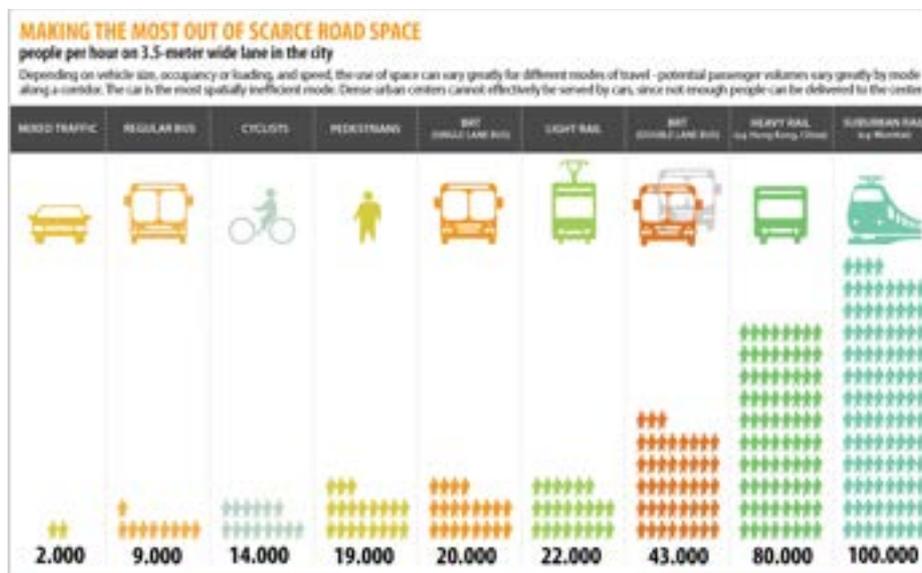


Figure 3: Walking and Cycling are the most space efficient and cost effective modes of transport

Source: Deutsche Gesellschaft für Zusammenarbeit

² The proportion of trips made by a specific transport mode, usually represented as a percentage (%) of each mode.

³ The case wherein people (in our case the decision makers) have an expectation about what another person or group (i.e. pedestrians and cyclists) favour, which influences how they act toward that person or group, which causes that person or group to behave consistently with people's original expectations, making the expectations come true.

⁴ Aronson, E., Wilson, T. D., & Akert, R. M. (2005). *Social Psychology* (5th edition). Upper Saddle River, NJ: Prentice-Hall.

The Pedestrian

Walking is the most basic form of transport we as humans learn even before riding a bicycle or before getting behind the wheel. Historically, all our cities were built with walking in mind, the sizes of the historic cities are fit for walking and the streets, which were roads in the past, are narrow and favoured walking. The advent of the automobile has changed the urban fabric. Streets became larger, footpaths became smaller and in many cities non-existent. Pedestrians were slowing forgotten as people who also use the road and in many cases perceived as slow “traffic” that reduce the speed of automobiles. The solution to remove the slow traffic is usually to either make it illegal for pedestrians to walk or make walking so cumbersome that they voluntarily do not use the road space.

It is common in many of our cities to see pedestrians walking behind barricades on the footpaths, or in some cases a meshed grill. Imagine this picture if you are in a car and look onto a pedestrian who is walking behind a barricade, it is an unfavourable scene for the motorist and no motorist would want to be treat so, hence they deter from walking.

Yet when we go shopping to a mall or a large market, we walk for hours, we watch other people, we stop and take out time in front of a clothes shop or touch and feel the fresh vegetables at a grocer. We do not mind eating at shop that is on a bridge in a mall. Why do we have a different view of walking when we are in a mall or a large market? Why do we refrain from walking on the road?

In this section I try to put forward a simple argument that explores the reasons and possibly answer the above questions. An answer to both of the above questions is as pedestrians we need space to walk. It is very evident that there is heaps of space in a mall for walking, we never see a car or a motorcycle passing us – if you do not count those exhibits in malls. I boldly take a step further and break down the idea of SPACE, in spatial terms yes pedestrians need space, yet there is something more to space that pedestrians need and I was able to put the elements into the word SPACE, luckily.

To express our ideology for creating pedestrian friendly cities, I turned the word space into a mnemonic **SPACE**, which stands for **S**afety, **P**riority, **A**ccess, **C**omfort, and **E**nforcement.

In this section I will try to elaborate each of the self explanatory elements of SPACE, which I think is the recipe for creating a pedestrian friendly city.



Photo 1: Walking is the most basic form of mobility in cities

Santhosh Kodukula, 2014

Safety first

Every pedestrian in an automobile friendly city⁵ is scared to walk on the streets. Automobile friendly cities tend to have high speeds on the streets and narrow or no footpaths, cumbersome pedestrian crossings, if footpaths are available they are often unprotected or encroached upon by motorists forcing the pedestrian on the arterials.

The policy makers who know that it is unsafe for pedestrians to be walking on the streets with cars, usually favour pedestrian overpasses – those bridges we see for pedestrians to cross the road. These bridges are seldom used as they only increase the effort required to walk, imagine climbing a flight of 50 steep stairs and walking over 8 lanes and then climbing down another 50 steep stairs. The experience is daunting and it is horrible if you are a senior citizen or someone who has special needs.

Footpaths in many of the automobile friendly cities are not complete i.e. they have either open man holes, or the paving blocks are wobbling. This increases a safety risk and especially during evening and low light times. Also properly unlit pedestrian areas and footpaths next to a tall wall increases security concerns.

Speed of the automobiles is another major factor that affects the safety situation of pedestrians. Several studies found that any speed greater than 30 kph will greatly increase the chances of a pedestrian dying in the event of an accident between a motorist and a pedestrian. This reminds me of an adage commonly found on Indian highways “Speed Thrills, but Kill”, which is true in our case. It is strongly suggested that our cities cap the speed limit in the city and residential areas to ≤ 30 kph, for the safety of our pedestrians and our children who are playing on the streets, who are also pedestrians.

Further, to promote walking in our cities we need to provide safe and secure footpaths. The footpaths need to be physically segregated, by raising them so that motor vehicles do not encroach and not by placing a barricade or a meshed grill.

It is also suggested that wherever possible pedestrians cross the roads and junctions at grade i.e. without the use of pedestrian overpasses or underpasses. In cases where it is not possible to avoid building an underpass i.e. below a train track, sufficient care has to be ensured that such a passage is well lit especially in the evenings.

Safety becomes the major factor for any person contemplating to walk in a city. A safe city will attract people to be on the streets.



Photo 2: Crossing roads in many developing cities is unsafe and also without proper pedestrian crossing

Santhosh Kodukula, 2011

⁵ Cities that favour automobiles i.e. cars and motorcycles to promoting walking, cycling and public transport. Automobile friendly cities are categorised based on their modal split of automobiles to NMT and Public Transport.



Photo 3: Situation changes when pedestrians feel safer

Santhosh Kodukula, 2011

Priority for pedestrians

If we think of the walk in the mall or market experience, you will see that pedestrian are the only traffic on the street. Pedestrians are given the priority, even if there is a motorcycle coming through, they immediately realise that they have to either slow down or even take a different route.

The same principle applies also for designing for pedestrians in our cities. When we prioritise our roads and streets for pedestrians and their activity there is an acknowledgement from other transport modes.

Prioritisation can be done initially from the amount of road space that is allocated for pedestrians e.g. a footpath with that does not compromise with the width of the carriage way⁶. A pedestrian signal that runs longer than a signal for automobiles. When priority is combined with safety we have a wide gamut of solutions to change our existing streets, such as median islands on large roads that gives refuge for a pedestrian crossing 8 lanes of traffic, regular “functioning” traffic signal to keep the speed of automobiles at 30 kph. Adequate pedestrian crossing and less frequent pedestrian “overpasses”.

Cities that are bold enough would undertake a out-to-in planning approach, in which the planning of new road space is done from the outermost parts of the road i.e. the edges by giving sufficient space for footpaths, then to bicycle lanes, then the space for public transport and finally to the personal automobiles. Some cities also ignore the personal automobile if no space is available after allocating for pedestrians, cyclists and public transport. Is your city bold enough?



*Photo 4: Several developing cities succumb to motorisation and are distancing themselves from non-motorised transport. Developed and richer cities are drawn closer to walking and cycling.
Carlos Pardo, 2007*

*Photo 5: Developed and richer cities in many countries are favouring walking and cycling in their core business districts.
Santhosh Kodukula, 2014*

⁶ The road space for automobiles.

Accessible footpaths

We have seen until now the importance of safety and priority, these two factors alone make a lot of change and in order to amplify the benefits making pedestrian areas accessible brings a entire different quality to our cities.

Thinking again of the mall experience, how many times have you got lost in a mall searching for a shop, the chances are very low compared to the number of time you forgot the place where you parked your car in the same shopping mall. Also how difficult is it to take people with special needs go around in a mall, I doubt it is difficult. This is called accessibility.

We need to take a step back and ask ourselves, how easy is walking in my city?

If walking is defined only in the city centre then would people drive to walk in the city centre. We want our people to walk everywhere, in order to do that we need to create a walking atmosphere that is welcoming and informative to all users.

Our footpaths need to have provisions for wheel chairs and people with special needs. We need to have way-finding systems in place for people to find their destination easily.

In many European cities pedestrian areas i.e. city centres and business districts have the best accessibility various utilities are within reach and so are places for leisure i.e. to sit and drink a coffee or read a book or simply gaze at passersby. The best part is that businesses encourage pedestrian areas as it increases their revenue, and these are the same businesses that initially opposed the idea.



Photo 6: Inaccessible footpaths are a common sight in many cities that do not prioritise walking. This example is from the United States of America.

Santhosh Kodukula, 2013



Photo 7: The central business district in Sydney is a pedestrian area. The rental value of the shops has increased since the district became a pedestrian area.

Santhosh Kodukula, 2014

Comfortable footpaths for walking

Comfort in walking comes from the feeling that you are not thinking that you are walking but are lost in a conversation with your partner or you are just enjoying the weather, thinking about a date that you are walking to. Comfort definitely does not come from checking for open potholes, or trying to avoid the electric pole in the middle of the footpath, or to figure out how to go around a pile of rubble carefully placed on the footpath. The latter is the case that may sound very common to many of us living in cities that adore automobiles. Comfort is a privilege given to automobile with their wide unobtrusive roads, less or no stops.

In many of our cities footpaths are the placeholders for electric poles, refuse from motorists, utility boxes i.e. telephone exchange boxes, electric boxes etc. Pedestrians are supposed to share their already narrow space with these other stationary objects.

This can be surely avoided with by providing proper widths for footpaths. A properly planned footpath will take into account the additional needs of space. This can be achieved from the out-to-in planning that was mentioned under the priority section.

Further, greening the pedestrian areas and providing street furniture such as seating, potable water will increase the comfort level. In business areas relaxing the regulations to allow cafes and small businesses to serve on the streets will initiate a creation of convivial streets and make the previously car-infested street into a lively and comfortable pedestrian area.



Photo 8: Pedestrians often have to sacrifice their comfort to various obstructions on the footpath and to the rubble that is disposed on a footpath.

Santhosh Kodukula, 2005



Photo 9: Providing green areas and wide footpaths will support creation of convivial public spaces.

Benjamin Hickman, 2005

Enforcement

While Security, Priority, Accessibility, Comfort create a lively pedestrian environment the last factor i.e. Enforcement is the most vital for a continued pedestrian environment. In order for the efforts put in by the city to sustain enforcement plays a crucial role. We might wonder where can we enforce or does enforcement mean to force people to walk, the answer is no. Enforcement is required to allow pedestrians have all the benefits that were created for them.

A common issue that begs for enforcement is the encroaching of footpaths by vehicles for parking. In many cities parking on the footpath is common and enforcement officials seldom take this as a common scene and ignore this. Such negligence will cost in terms of the effort put in by the city to promote walking. Encroached vehicles need to be properly informed that a footpath is not a place for parking and if required also be penalised for parking on a footpath.

Enforcement is also required when vehicles go beyond a stipulated speed limit on a road. Ensuring that speeding vehicles are penalised will increase the confidence among non-motorists and also increase the visibility of non-motorists.



Photo 10: Encroachment of pedestrian space is a common sight in many cities that are becoming victims of motorisation.

Carlos Pardo, 2008



Photo 11: When Pedestrians are given the space and when proper enforcement is in place the true purpose of a street is realised.

Santhosh Kodukula, 2009

What is an Ideal footpath

We might wonder what is an ideal footpath. The answer need not be complex. A footpath that is safe from automobiles, one that is planned keeping the needs of the pedestrians in mind, one free from obstructions, one that lets people walk side by side and more importantly one where people want to visit again is an ideal footpath.

Pedestrian friendly environments segregate pedestrians from vehicle traffic, improve the visibility of vehicles, and proper communication through signs, and provides assistance to pedestrians with special needs (US DOT, AAA & NSC, 1994).



Photo 12: Is this an ideal footpath?
Carlos Pardo, 2010

Design Specifications for a dedicated footpath

For those who are technically inclined, the following specifications should serve as a guide for creating walkable footpaths in our cities.

Minimum width: 1.5 metres (considering also the use of wheelchairs), maintained in the entire course of the footpath i.e. even at turns and bends

Accessibility: Ramps are provided at crossings on both sides

Coherence: Footpaths are not obstructed by street furniture and municipal utilities

Segregation: Footpaths are physically segregated from motorised vehicles either by on street parking and/or greening of the edges



Cyclists and their needs

Cycling is a part of almost everyone's childhood. We rode a bicycle as kids and enjoyed the freedom, we also encourage our kids to ride bicycles to have a similar experience. A bicycle is the first experience we have of a vehicle with wheels. As time passed we stopped riding our bikes as we realise that the streets are getting increasingly unsafe for cyclists, with fast moving automobiles and lack of space for riding a bicycle and also a popular myth that cycling is for only the poor. The effects of increased motorisation are encouraging cities to make cycling more attractive as it is a more sustainable mode of transport with added benefits on health and liveability.

The advantage that many cities in Asia have is the number of cyclists are already high compared to many European cities. Due to an increased affection to automobiles cycling is neglected. The majority of the existing cyclists are the ones that cannot afford motor vehicles and live in areas with little or no public transport service. The lack of proper infrastructure coupled with the images of the poor cycling create a perception that cycling is for poor people. In many European cities, that have a higher GDP per capita than Asian cities, cycling is a common not linked to ones social or economic standing.

Just like planning for pedestrians, planning for cycling is not a herculean task. Cyclists and pedestrians are the least demanding users of road space, if they are considered in planning. They pose a very little cost compared to the infrastructure provided for cars and provide a greater economic, social and environmental benefit to the city than automobiles.

For people to bicycle more in our cities, we need to provide space for cyclists in the form of bicycle lanes/tracks. The experience of cycling is further improved when the bike routes are Connected, Direct, Safe, Comfortable and Attractive (CROW, 2007).

Connected/Coherent Routes

A basic requirement for promoting cycling is the provision of space for bicycles to travel. This space between an origin and a destination is termed as a route. It is essential for routes to be connected.

Connected not only means that there needs to be a continuous demarcation of space for bicycles but also that they are complete. No motorist would enjoy riding their automobile if the road suddenly disappears and again pavement start after an interval, and neither do we plan our roads in such fashion. Similarly, our bicycle routes need to be complete and continuous with out an obstruction from any municipal utility or a puzzle left for the cyclist to figure how to ride the next leg of the ride.

Connected routes are easy to plan when an origin and a destination are decided. All that remains is connecting these points through a space for cyclists that is clearly demarcated and is made of the the same material i.e. coherent and there are no disturbances be it from parked automobiles or from construction/renovation works.

It is also advised that bicycle lanes are segregated from pedestrian spaces, keeping in mind the speed of cyclists is higher than that of pedestrians. Hence, segregation ensures safety of both cyclists and pedestrians.



Compare these pictures and decide which is a more connected and coherent route for cyclists.

Photo(left) Santhosh Kodukula, 2010

Photo (right): GIZ Photo DVD, 2011

Direct Routes

A connected route that was discussed above can be disused if it is circuitous, when compared to reaching a destination on an automobile. Such circuitous routes not only deter the use of bicycle in the interest of time but also give a perception to the decision-makers that bicycle routes are ineffective.

A successful practice in many cities that increased their bicycle numbers is to have direct routes. In other words, direct routes are routes that require less time to travel to the destination for a cyclist compared to a motorist. This is achieved principally by obstructing the travel for automobiles and giving a longer and more convoluted route for the automobiles while allowing bicycling on designated areas in automobile restricted zones. Bi-directional bicycle routes on a one way road for automobiles is a common practice in many European cities, this practice enable bicycles to gain travel time while the automobiles are taxed with travel time.

Similarly, many city centres in European cities are automobile free. Bicycles and pedestrians have a free access to the core of the city centre while automobiles are stopped at the periphery of the city centre.

Direct routes enable cyclists to reach a destination faster as there are fewer or no detours on a direct route. If riding a bicycle to the destination takes shorter than driving an automobile, people will more likely use a bicycle - this applies also to motorists who own a bicycle.



Photo 16: A bi-directional bike lane and one-way automobile lane is a common sight in many European cities. Other countries are being inspired by the effectiveness of such practices and are implementing bicycle priority lanes.

Andrea Braoddus, 2007

Safe Routes

Safety is a major concern among non-motorised transport users and potential users who are contemplating using non-motorised modes. Creating a safe environment for walking and cycling will not only attract users but also increases the priority that a city gives to non-motorised transport.

Safety in cycling can be ensured mainly by avoiding mixing of traffic on the designated bicycle routes. Reducing the speed of the automobiles also increases the perception of safety among cyclists. In the cases where the speed of automobiles cannot be reduced to 30 kph, it is strongly suggested that cities implement physically segregated bicycle lanes.

Studies also found that an effective way to increase the safety among cyclists and on cycle routes is to encourage more people to bicycle (Jacobsen, 2003⁷; Robinson, 2005⁸). It is also found that activities that reduce the number of people who bicycle, such as mandatory law to wear a helmet, increases risk for the people who continue to bicycle.

A study also found that having narrow lanes i.e. < 2m may be an ineffective in reducing the conflict between motor vehicles and cyclists. On the contrary having wider lanes will ensure a reduced conflict between motorists and cyclists⁹.



Photo 17 (left): The city of Sydney is a fairly new comer into the world of cycling friendly cities, yet the city started right by providing physically segregated bicycle lanes. The lanes not only increase safety for the cyclists but also display the priority the city gives to its bicycling citizens.

Santhosh Kodukula 2014

Photo 18 (right): Segregation bicycles from pedestrian traffic is crucial due to the difference in speed of pedestrians and cyclists. This is done mainly through providing different experience on each of the surface. Bicycles find it difficult to ride on a footpath and pedestrians find it more comfortable to walk on the footpath.

Santhosh Kodukula 2014

⁷ Jacobsen PL, 2003. *Safety in numbers: more walkers and bicyclists, safer walking and bicycling*. *Injury Prevention* 2003;9:205-209.

⁸ Robinson DL, 2005. *Safety in numbers in Australia: more walkers and bicyclists, safer walking and bicycling*. *Health Promotion Journal of Australia* 2005;16:47-51.

⁹ Taylor & Francis. (2014, October 14). *Do cycle lanes increase safety of cyclists from overtaking vehicles?*. *ScienceDaily*. Retrieved November 12, 2014 from www.sciencedaily.com/releases/2014/10/141014083840.htm

Comfortable Routes

Comfort is both a perception and a reality when it comes to cycling. People who seldom bicycle find cycling less comfortable if the existing cycling facilities are unattractive, unsafe and are not connected.

The main aim of creating comfortable routes is to show that cycling is fun, safe and enjoyable. At the same time cycling is more efficient for urban travel. To meet this aim, cities need to ensure that the cycle routes that are well maintained in terms of surface quality. Uneven surfaces on the bicycle route make riding less comfortable due to vibrations. Like driving over a series of speed humps.

In addition to having well maintained bicycle lanes, providing proper signage and way finding with bicycling distances will increase the comfort for a cyclist. Providing priority for cyclists at traffic signals, by having a separate cycle for bicycles or having a advanced green than automobiles, will reduce conflict among motorists and bicycles and increase comfort.

A brief history of cycling in Amsterdam, the Netherlands

Cycling became popular in Amsterdam in the 1920s. At the time, 80% of journeys were by bike. Car traffic began to increase in the 1950s and by the 1960s, it had quadrupled – at the expense of bikes. Traffic safety fell dramatically as a result, culminating in more than 100 fatal traffic accidents in the early 1970s. This was one of the most significant reasons behind attempts to reduce automobile traffic and encourage cycling (both initiatives that were supported wholeheartedly by residents of Amsterdam). It was around this time that the City of Amsterdam started work on the network of dedicated cycle paths running through the entire city.

Cycle usage subsequently began to increase. The introduction of paid car parking in the centre of Amsterdam in the 1990s also resulted in a dramatic increase in bicycle usage.

Between 1990 and 2014, the number of people using bikes has more than doubled. Currently, more than half of all journeys in Amsterdam city centre (within the A10 ring road) are by bike. In the historical city centre, that figure rises to 60%.

Source: <http://www.iamsterdam.com/en-GB/Media-Centre/city-hall/dossier-cycling/Cycling-FAQ>



Attractive Route

In addition to making bicycle routes connected, direct, safe and comfortable, the icing on the cake is making the routes attractive and visually distinguishable.

Having a specific for bicycles will not only set them apart from the other vehicular traffic but also give a sense of priority among cyclists. Attractiveness of the route can be done both in terms of the visual appeal and in utility. Cities paint bicycle lanes to distinguish bicycle lanes and regular traffic lanes. Copenhagen introduced dustbins specially designed for bicyclists such that they need not stop to throw rubbish into a bin. Similarly, the city of Münster in Germany provided a green promenade that circles around the city centre and is open only for cyclists and pedestrians. The promenade provides a direct, safe, connected and an attractive route.



Photo 20: European cities have a high bicycle usage not just because cycling is safe, cycling is more convenient and more attractive than using an automobile for everyday chores.

Santhosh Kodukula, 2013

Case Study: Freiburg, Germany

Authors: Ciara Leonard and Santhosh Kodukula, ICLEI

Introduction

Freiburg im Breisgau is a medium-sized city situated in Southwest Germany, close to the Swiss and French borders, in the Federal State of Baden-Württemberg. This well-known city in the Black Forest region has developed an identity as an “eco Capital of Germany” due to a long tradition of mainstreaming environmental policy. Since 2008 it also profiles itself as a “Green City” – seeking to reflect on issues impacting on sustainability and high quality of life.

Freiburg’s population growth rate lies at about 1% per annum. Currently approximately 220,000 inhabitants call Freiburg home, with about 30,000 of these making up the very visible student body.

The city itself is extremely compact with 90% of inhabitants living within a 5km radius. An extensive public transport network links the various neighbourhoods via four tram lines and a web of bus routes. 90% of residents have a public transport stop within 500m of their homes.

Freiburg is a cycling city. The compact urban structure, favourable topography and climate, as well as the high proportion of students, all lend themselves towards cultivating a vibrant cycling culture. Here, the bike is a means of commuting, as well as of leisure. It was awarded the accolade of Bike-friendly City (Fahrradfreundliche Stadt) by the Baden-Württemberg government in 2011.

Currently, 420km of cycle paths exist in the city. Of these, 140km, run alongside roads and 30km are

physically separate routes. 130km run through bike-friendly streets, with 120km of forest or field track in place.



Photo 21: Freiburg a bike-friendly city with all modes.
Ken Hawkins, 2012 - <https://www.flickr.com/photos/khawkins04/>

Mobility policy in Freiburg

A pioneer in sustainable mobility, Freiburg’s transport policy has drawn national and international attention for the priority that it asserts to environmentally- friendly modes.

It was first in 1969 that the City of Freiburg undertook the development of an urban transport policy, which sought to ensure a good level of mobility without encroaching upon urban development, nature and the environment. The first major decision at this time was to keep the existing light rail infrastructure and develop this into a modern tram network. In 1973, the city's first pedestrian zone was established.

By 1979 the General Transport Plan for the city needed to be upgraded. Planners and politicians seized the opportunity to shift the focus away from car-centric measures and to further extend the public transport network and promote means of non-motorised transport. Freiburg was the first German city to introduce a "regio-card," a monthly non-personalised public transport ticket allowing the use of trains, trams and buses in the city and region surrounding the city.

A decade later a further revision of Freiburg’s Transport Plan took hold and these original principles were given new impetus. Since then, the city has recorded a drop in inner-city motorised traffic of 38 to 32%. In comparison,

the proportion of cyclists rose from 15 to 27%, while the take-up of the public transport offer rose from 11 to 18%.

Despite increased public transport integration with the city's hinterland, a rising population and an increase in the number of trips made per citizen, the city has succeeded in holding the proportion of motorised traffic at low and decreasing levels. Tactics, such as concentrating traffic on arterial roads, the introduction of parking restrictions and 30kmh speed limits in all residential areas have in part served to encourage drivers to leave cars at home where possible, or to not even acquire one in the first place. With 337 private vehicles per 1,000 inhabitants, Freiburg has a lower automobile density than most similar sized cities and, indeed, significantly less than the state average for Baden-Württemberg.

Looking at cycling, the first bike plan was made in the 1970s. Back then there was only 30km of bike paths in place. Today's network of over 420km of well-connected routes is a testament to the consistency with which cycling has been viewed by the city as a bona fide mode of transport. The establishment of 30km zones in residential areas has further underlined these efforts, creating a pleasant environment for Freiburg's cyclists.



Figure 4: The 2011 plan seeks to bring more green into the city's modal split.

Complementing the paths are approx. 400 signs indicating to cyclists the best options for reaching their destination and over 9,000 bike parking spaces across the municipality.

Pedal to the metal: Freiburg's Cycling Concept 2020

With much already done, Freiburg is not resting on its laurels however. The Cycling Concept 2020 is a testament to the city's vision and ambitions to offer real alternatives to its citizens and solidify its reputation as a sustainable mobility champion.

Concretely, the Cycling Concept 2020 seeks to increase the modal split of cycling within Freiburg to well over 30% by 2020. Should this be achieved, Freiburg's position among the best cycling cities of Germany would be assured. In line with this, a recently commissioned study indicates that if the target for motorised transport sinks as projected by 12% by 2020, Freiburg could become a climate- neutral municipality by 2050.

But the environment will not be the only beneficiary. Through the provision of better bike paths and signage, cycling in Freiburg would be made safer. The city hopes to reduce the number of accidents recorded annually by half.

The provision of better surfaces, regular winter services and number of covered parking places should also serve to make cycling in harsh weather more attractive. This in turn would relieve the pressure on public transport at such times, making this more efficient.

Nature protection is another aim embedded in the Concept. The planners seek to relieve pressure on the natural environment by improving existing bike paths and constructing new sections in a manner that poses as little conflict as possible with soil, habitats and ecosystem services.

Plan in action: Better and safer cycling in Freiburg

The Cycling Concept 2020 allows Freiburg's planners and politicians to approach the issue of increasing cycling opportunities in the city in a systematic manner, allowing for a realistic snapshot of the issue and the steps that can be taken to achieve their aims of better and safer cycling in the city.

The first step was to divide potential cycle routes into three categories, namely secondary, primary and priority routes. This categorisation should allow prioritisation and goal-oriented planning and implementation of the necessary measures.

The ranking of the categories reflects the significance of each path in its local context. Instead of following rigid, uniform criteria, the routes are ranked in terms of location, network density, destinations along the route, and current condition and potential.

In the discussions about the routes and ensuing categorisation, the Garten- und Tiefbauamt, the department responsible for green spaces and building, also took into account the connection of the cycling network to important destinations with corresponding high-levels of traffic, e.g. the university, hospitals, large employers, retail centres. The connection of the cycle network with villages and small towns bordering the city was also an important factor in the categorisation of the routes.

Where possible separate cycle paths are the preferred format. Not only do these deliver a very pleasant and positive experience of cycling, demographic developments within the city reinforce the demand for such routes. Older, but still active, persons, families with children, more sporty cyclists and the ever increasing number of semi-motorised electric bikes create a demand for wider, straighter routes that do not compete with motorised traffic.

While it is not possible to deploy this format across the entire city, the Cycling Concept 2020 looked at these developments and proposes some measures to address them.



*Photo 22: Freiburg's city centre offers 5,000
Manfred Breithaupt, 2013*

Priority routes for efficient cycling

The priority routes mark a quality gain for Freiburg's cycle network. Constructed to high-level specifications, such routes allow cyclists to travel undisturbed and rapidly along barrier-free paths.

Although the planned route will represent a more rapid and fluid cycling experience in Freiburg, the term "cycle highway," which often crops up in the Danish and Dutch contexts, has been deliberately excluded from discussions. There are a number of reasons for this.

Firstly due to the urban constraints of the city, the standard characteristics of such routes, e.g. minimum width of 4m, cannot be implemented. Secondly, the association of the term cycle highway with "speed" was not felt to truly express the nature of the routes. Instead, "priority route" was chosen to emphasise the fact that the route is given priority over traffic and therefore has an advantage over other modes.

On these routes, there is a definite emphasis on separate paths in order to reduce waiting times. This is achieved either by making the paths junction-free or by giving bike traffic priority where there is no other option but to cross a street.

Priority routes are wide. Where the space is used just by bikes, it is wider than 3m, where use is shared between bikes and pedestrians, the width is approximately 4.5m. In all cases there is a good asphalt surface with few sharp bends or abrupt inclines. Where possible, these will be well lit also for good visibility.

Where the priority routes interact with main roads, the width is maintained where possible at equal to or greater than 2m. Priority for cyclists will be achieved by implementing a "green wave" in the traffic light sequencing, which will be configured to suit average cycling speeds. This must be done in a way that is attuned to and deliberated against existing measures to reduce emissions and noise. It must also not impact on public transport efficiency.

Along secondary streets, cyclists will have priority and road surfaces will be addressed to make cycling as pleasant as possible. It is still being explored whether these streets will be able to cope with their linking function within the projected routing.

Three priority routes are currently being developed for piloting.

Complementing the priority routes are main routes and secondary routes. Main routes also have a high capacity and allow cyclists to travel at a relatively comfortable speed. On sections with separate cycling path, these are approximately 2.5m in width. Should cyclists and pedestrians need to share space, the paths will be equal to or greater than 3.5m wide. Once paths intersect with other roads, this will be scaled down as appropriate. Surfaces will be of a high quality and the vast majority will be straight.

Secondary routes are simpler, more basic routes, however these play a large role in closing the circle of the new system. Surface quality will still be quite good. Where it is possible to have bike paths, widths will fluctuate between 2m on separate paths to 1.6m where space must be shared. On smaller streets bikes will mix with the rest of the traffic.

More than just cycle paths - looking at a bigger picture

Complementary to the achievement of the aims of the Cycle Concept 2020 and all the proposed routes are good **bike parking** options at journey source, destination and intermediate halts, e.g. bus or tram stops. Good parking is sufficient in quantity, easy to use and easily accessible. By protecting bikes from inclement weather and theft, the inhibition threshold will be kept low and cyclists will be encouraged to purchase better and safer bikes.

Opening one-way streets to bike traffic closes gaps in the cycle network and reduces unsafe behaviour, such as cycling on pavements. With speeds kept low, streets sufficiently wide and good visibility in place as standard, cyclists and drivers tend to take more notice of each other and conduct themselves more safely.

An **integrated approach** in terms of addressing cycling policy within the city administration will be needed to ensure that all departments with a mandate including an aspect of cycling will need to cooperate more closely to avoid redundancy.

For a number of years now the Garten- und Tiefbauamt has had a **cycling representative**. The responsibilities of the position are split between planning and maintenance of cycling infrastructure. The cycling representatives develop concepts and measures for the further development of cycling in the city. They also manage the proportion of the budget reserved for cycling and develop the physical infrastructure. Importantly, they serve as a point of contact for the public when queries relating to cycling or pedestrian issues arise.

Engaging **public relations and marketing** activities to accompany the hard measures are needed to stimulate people to get on their bikes and follow the rules. Recent campaigns have encouraged citizens to use bikes instead of their car within the city for short journeys (www.kopf-an.de) and to be more considerate in their actions on the road (www.freiburg-nimmt-ruecksicht.de).

A functional marketing tool is the bike counter recently erected along a busy cycle route. It shows the number of cyclists and the amount of CO₂ saved as a result of their trips.



*Photo 23: Freiburg does just think about promoting cycling, pedestrians play a crucial part in completing the city mobility future
Manfred Breithaupt, 2013*

Good **data collection** is also central to efficient policy development.

Regular maintenance is extremely important to ensure cycle paths of all categories are utilised and safe. This is a labour-intensive task involving the constant removal of roots, and path resurfacing. Paths should also be kept clear and free of dangerous objects. For that reason the city's sanitation department has set up a **shard-hotline** for citizens to report broken glass on cycle routes.

A good **winter service** helps to make sure that cycle infrastructure is used more consistently and is not quite so weather dependent. The priority routes outlined above will have a high level of servicing during bad weather.

Signage is currently quite extensive; however, this needs to be constantly kept in check to ensure stock remains in a good state and to keep up with an ever expanding network.

As well as the physical and operational measures put in place, it is also important to preserve and regularly update knowledge about existing cycle infrastructure. In order to be awarded the distinction Bike-friendly city again by the State of Baden-Württemberg this will have to be explored and a **digital cycling register** implemented.

Expanding the horizon of Freiburg's cycling policy

Looking to the future, the City of Freiburg will explore what possibilities exist to cater for increasing numbers of **electric bikes** and other motorised two-wheelers. Public bikes can be a positive feature for tourism development in Freiburg, as well as increase the profile of ecomobile transport options within a city.

The further integration of cycling in a **multi-modal concept** is also on the agenda. Bike & Ride will continue to be supported through the provision of parking furniture at new tram and bus stops, as well as car sharing locations.

Gains in the **built infrastructure** will be preserved and regularly updated to ensure that Freiburg's cycle path network remains of a high quality and continues to put safety first.

Budget and Finances

Naturally, the realisation of the aims and implementation of the measures outlined in the Freiburg Cycling Concept 2020 will require the investment of significant funds. Public money must be spent carefully, ensuring value for money for the taxpayer.

With the implementation of measures to promote cycling realised at roughly a tenth of the cost for similar measures for cars, the city administration can safely assume good value for money in terms of the activities documented in this case.

The government of Baden-Württemberg has announced that one of the goals for its tenure is a doubling of the current modal split for cycling across the state. To achieve this, it has made special funds available to cities, who can apply for up to 50% of the cost of the implementation.

Currently Freiburg has a budget of €3.5 million for 2013/2014 to develop and implement the first steps of the Cycling Concept and the capacity of approximately three members of staff to develop the plans and oversee the implementation of the pilot routes.

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Case Study: Münster, Germany

Authors: Santhosh Kodukula and Hana Peters, ICLEI

Introduction

Münster is a city name that is synonymous with bicycling in Germany. With approximately 296,000 inhabitants and a cycling modal share of nearly 38%, Münster is often referred to as the bicycle capital of Germany. The modal split for residents for the year 2011 showed a high proportion of nearly 64% of trips attributed to the Environmental Network of pedestrian, bicycle, and public transit. Urban development has been promoted with the objectives of saving resources and ensuring environmental compatibility for decades to come. The evolved city structure – a compact and lively centre, attractive district centres, and a virtually ideal green system – ultimately provides the ideal preconditions to this end, and demonstrates a firm commitment to the future. There are also many universities in Münster with outstanding international reputations, accommodating approximately 50,000 students. The city also hosts several headquarters of innovative centres in the fields of research and technology transfer.

The City of Münster takes an integrated and very citizen-oriented approach to urban development. In terms of mobility, this means that it makes efforts to accommodate a variety of modes of transport, with a structure and urban design that shape and impact the transport patterns. In contrast to Münster's compact urban design, large, sprawled cities have longer routes to consider when developing new and improved transport options. Providing for cycling and public transport in large cities is cumbersome and costly when compared to their more compact counterparts. Since it is relatively dense, Münster is therefore able to fulfil two environmental objectives: reducing emissions and protecting open countryside.

On a typical workday, approximately 1.43 million journeys take place within the city's transport network. Residents account for around 1.06 million of these trips, with visitors from out of town accounting for the approximately remaining 371,000. The 2007 modal split was 10.4% public transport, 15.6% pedestrians, 36.3% car, and the highest, 37.6% for bicycles. The driving goal is to reach a 50% modal share for cycling within the next 10 to 20 years.



Photo 24: Bicycle are omnipresent in Münster
Georg Doehn, 2010

Role of Cycling

Cycling can help reduce pollution and traffic congestion. Bicycles have low energy consumption and bring health to their users. They can also provide quick, affordable access to parts of cities that are more difficult to reach by public transportation, or large vehicles. In many cases, trips made by car are short enough to be substituted by bicycle. Making cycling and walking easy makes a city people-friendly rather than car-friendly.

Bicycle traffic is the embodiment of Münster's transport system. Bicycle traffic is a tradition both in the city and the Münsterland region. Since the 1950s, Münster has promoted cycling by means of planning and consistent implementation. And this strategy has always been based on a sound overall concept, rather than single measures: the success of an urban cycling concept depends largely on the design of an integrated system.

Bicycle traffic in Münster is divided into a core network that runs primarily in conjunction with the main roads (for the most part on dedicated cycling lanes), and an ancillary network characterised by routes removed from the roads, either along agricultural paths or as dedicated cycling lanes.

Attractive walking routes, together with open and inviting building facades that are designed at a human-scale height make the urban space of Münster feel more accessible for pedestrians and cyclists. Better signs and way-finding for cyclists and pedestrians also make it a more desirable place to pass through or access by these modes. These measures also serve to make public transport more accessible, as it allows non-motorised transport users to navigate their way to the nearest bus stop.

Bike parking facilities

Germany's largest bike parking station is situated close to Münster's central train station. It provides 3,300 places. In addition, it offers every imaginable service: a repair shop, a bike washing bay and rental outlet, lockers, and much more. Because of its great success (all the places are used), a second one will be built at the opposite end of the railway station. This will further encourage travellers to cycle to and from public transport.

Circular promenade

The city has a primary network for cyclists in the form of a circular promenade encircling the old town, which helps distribute bicycle traffic and which serves as a connecting link between the bicycle tracks along the main artery roads and the unobstructed thoroughfare through the old town. Additionally, all residential areas are 30 km/hr zones, thus promoting safety for cyclists when they share the streets with cars, even in the areas when there are the separated priority lanes for bikes. Sign posting for bicycle traffic along 245km of the network adds to the ease of use and links the network to neighbourhoods and public transport.

To further assist with way-finding, a bicycle city map is available in shops throughout the city.

Infrastructure – upgrading & maintenance

Within the realm of cycling, Münster is currently focusing especially on the upgrade and maintenance of bicycle traffic infrastructure, road safety, and information services. This includes good provisions for cycling infrastructure at early stages of development

in new residential areas. Within the context of the EcoMobility Alliance (see box), Münster aims to increase cycling in the city by up to 50% and gain perspectives on implementing and increasing other modes of eco-mobility. Identifying and taking advantage of synergies between eco-mobile modes such as bicycling and public transport is one approach. This will not only encourage regional travellers who must cover distances that exceed an easy cycling range to bike to a bus stop and take the bus to their destination (or vice versa), but will also increase the overall convenience of each mode independently.



Photo 25: The underground bike park (3500 bikes) at the central station in Münster, largest bicycle parking facility in Germany City of Münster, 2012

Cycling & public transport in Münster

Public transport is the core of a transport system in any city. Public transport that is arranged in networks is more efficient than a single corridor arrangement. Ideally, pedestrian and bicycle networks should feed into the public transport system, forming a synchronised intermodal whole. Münster exemplifies this ideal through local and regional bus transport complementing its ever-growing network of cycle lanes.

Local public bus transport in Münster is based on a city bus system, and a regional bus system (called ÖPNV). The former consists of a total of 19 lines running at approximately 20-minute intervals, or less than 10 minutes on the major traffic arteries during peak hours, and covers the entire city area, including the more removed outer-lying districts, connecting all of those areas with the city centre. The regional bus system covers both the rail line connections and the transport links with the surrounding region. Also noteworthy, are the express bus lines that provide high-quality transport in areas further removed from rail line connections.

Münster prioritises very early implantation of cycling provisions and public transport in new residential areas. Having good cycling and public transport infrastructure early on means that residents are provided with viable alternatives to the car right from the start. Consequently, they can adopt sustainable transport behaviours as soon as they move in, rather than having to change existing habits, which is usually much more difficult.

In order to persuade commuters in Münster to consider public transport, the so-called 'Public transport promotion programme' was set up and developed by the city council in 1993. This includes improving the speed and reliability of buses through mechanisms such as bus priority lanes, and measures to increase passenger comfort. Furthermore, bike & ride and park & ride facilities have been implemented at all rail stations and key bus stops.



Photo 25: Way-finding increases the comfort of cycling and makes the city more accessible to cyclists and pedestrians alike.
George Doehn, 2010

Citizens in the loop

The city of Münster makes a conscious effort to inform citizens and visitors about choosing an environmentally and climate-friendly mode of transport. For this purpose, the 'Mobilé' mobility centre was set up together with the communal transportation company, Stadtwerke Münster. Here customers are provided with information on the best travel options, as well as on potential alternatives. The mobility services also include providing information on road and rail traffic in the region, reduced tariffs for commuters and students, buses and trains that can all be used within the

integrated public transport system, and traffic education, and thus create greater awareness of the environmentally friendly transport choices available at a very early stage.

Lessons: By foot, on wheels

Cities aspiring to be more like Münster in terms of transport would be advised to start by accommodating both cyclists and pedestrians. In order to do so, they need to complete the public space network by linking up pedestrian routes, and by making bike lanes continuous and coherent. Reformatting existing roads to accommodate bike lanes is a crucial first step for increasing bicycle ridership. In many cases, multi-lane roads can spare a lane to be separated for cyclists, or street parking can be reduced to accommodate one. Bike lanes that are physically separated from car traffic are often safer, especially on streets with a thoroughfare speed of over 30km/hr. For rapid planning purposes, the lanes can be initially indicated by street signs and painted road markings; and the physical barrier to cars swerving into the lane can be implemented afterwards to improve quality.

Furthermore, beyond appropriate lanes and roads, installing proper bike parking facilities at various destinations is a quick and effective way of encouraging uptake of cycling. Such techniques do not require overhauling existing transport infrastructure, but rather merely adapting it to be more accommodating of sustainable modes.

When cyclists are prioritised in a city, and when this approach is combined with an effective public transport system, cycling and public transport become more viable options than driving. Cycling becomes the optimal choice for short trips, as does combining cycling with a bus ride for longer journeys.



Photo 26: In Münster every one use a bike in front of the historic town hall, even the lord mayor Markus Lewe himself. City of Münster, 2013

Contributors: Mr. Heiner Bruns from the City of Münster Department of Green Spaces and Environmental Protection; and Dietmar König from the City of Münster Planning Department.

Case Study: Boulder, Colorado, United States of America

An example of an integrated transportation system

by Saharnaz Mirzazad, Maritza Lee and Santhosh Kodukula

Introduction

Boulder, with a footprint of 24.66 square miles, is in Boulder County, Colorado. The 2012 Census estimates that the City population is 101,808, 80% of which are Caucasian. Boulder is among the most educated cities in the U.S. with 71.9% of adults attending college (Meltzer, 2010).

Boulder has an avid outdoor lifestyle. The city's location at the base of the Rocky Mountains has provided outdoor recreational opportunities for professional athletes and sports-oriented people. These natural features help attract around 30,000 students to the University of Colorado every year, making Boulder one of the most vibrant college towns in the U.S. (Florida, 2011).

Both the high cost of housing and a robust economy are contributing to a high number of commuters into the Boulder. According to the 2010 Census, the median house value was \$484,800, more than twice the average price for Colorado. The University of Colorado and National Laboratories in Boulder are among the largest employers in the City. The Colorado Department of Labor and Employment data indicates that the average annual wages of employees in Boulder is \$57,533, which is \$9,669 higher than Colorado average (Boulder Economic Council, 2012).

Transportation in Boulder, however, is a tale of two cities. Boulder's west side was developed before 1950 and has set a stage to provide a multi-modal transportation. In contrast, the east side, which developed later, is more car-oriented.

A balanced solution to multimodal transportation systems

Boulder's multimodal transportation system is based on buses, biking, and walking. Since 1990, the City's Transportation Master Plans (TMP) has been launching several initiatives to improve the transportation system, and find ways to make transit more appealing to users. Boulder's Community Transit Network provides regional and local services. The city surveyed residents to identify strategies to promote public transit ridership, resulting in new seat arrangements, larger windows, music, a sign with the driver's name, and contemporary graphics decorating the bus body (Transportation Division, 2012). Additionally, bus frequency is 10 minutes or less, and three times more often than before the program. The traditional hub and spoke transit system is being redeployed in a grid system to improve connectivity and reduce travel time for patrons.

However, the lack of a dedicated lane for regional bus system has been a challenge. Boulder City is therefore working with the Colorado Department of Transportation, and Regional Transportation District (RTD) to add a bus lane to U.S 36 Highway to decrease travel times. In addition, the funding shortage from the

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Photo 27: Boulder Creek Pathway between the Boulder Public Library and the Municipal Building

federal government has delayed this project.

The Eco Pass Program, the city's most recognised TMP tool, is a discounted annual transit pass offered to residents and employers. After the successful pilot in 1989, it was replicated as the University of Colorado's student pass program (1993), the Business Eco Pass (1993), and the Neighbourhood Eco Pass (1997). The Eco-Pass has been an essential and essential part to making transit a competitive element of the city's multimodal transportation system. The Eco-Pass holders use transit 5 to 9 times more than others.



Biking is not only another crucial component of Boulder's integrated transportation system, but also apart of the city's identity even before the first TMP. In 1977, Boulder hosted the first Bike to Work Day in the U.S. The adoption of the current TMP solidified the residents' engagement with bicycling. In 2011, the City of Boulder launched Boulder B-Cycle, a community bicycle sharing program with 22 stations around the city (Boulder B-Cycle website). Local and regional buses are equipped with bike racks and storage space under the bus. In addition, approximately 95% of Boulder's principal streets are bike friendly and have 159 centreline miles of bike facilities. An extensive network of paved shoulders and pathways are also included. Nevertheless, Boulder is struggling with bike safety issues. According to the Safe Streets Boulder Report, the cyclist accident rate is three times more than the pedestrian rate (Urie, 2012). The Transportation Department has emphasized providing streetscape

Photo 28: Boulder B-Cycle Station located at Downtown to provide shared bikes on hourly basis. This is one of the 21 stations in the city.

design solutions to reduce the rate of accident for the 2013 TMP update. Through Boulder's involvement in ICLEI's EcoMobility Alliance, Boulder is learning best practices from cities like Münster, Germany, in improving bicycle safety.

The third component of the system is walking. Every trip begins and ends as a pedestrian. Boulder is known for its unique environment favorable to pedestrians. In order to make walking more attractive, the City of Boulder implemented several initiatives such as the Missing Sidewalk Program, the Sidewalk Repair Program, and the Pedestrian Crossing Treatment Installation Guidelines (released 2006). Boulder's east side is still auto-oriented, and the City is working to address this issue through the Complete Streets Plan.

The Boulder Comprehensive Plan is the umbrella plan for all the city plans, including the Transportation Master Plan and provides for continuity and integration among the plans. For example, the Climate Action Plan has set GHG emissions reduction goals for the transportation sector and has provided funding to help achieve those goals. The Greenways Plan integrates floodplain management and transportation planning by providing grade-separated pedestrian and biking access along Boulder Creek and the fourteen (14) tributaries that transverse the city from west to east. The Open Space Plan increases the attractiveness of biking and walking as most of biking and walkways in Boulder continue throughout the greenbelt around the city. The city's parking revenue is providing Eco Pass funding for downtown employees. All the bus stations are equipped with bike racks for encouraging biking. The area plans are reflecting the big picture goals. For instance, Boulder is an example of bus-based transit-oriented development. In the Downtown area, which is close to the Boulder main transit centre, only one third of the Downtown employees are arriving by car (Transportation Division, 2012). The Boulder Junction transit-oriented development on the east side of the city is a new effort to integrate multimodal transportation, managed parking, walkable fine-grained neighbourhood, and dense, mix-use development.



Photo 29: The bus system is designed to carry the bicycles. The graphics on the bus have been pivotal in marketing. City of Boulder, bouldercolorado.gov

Collaboration with the regional transportation authority (RTD) and CU-Boulder to provide a complete transportation network has been an important part of transportation planning in Boulder. Implementation of non-local transit plans has largely been the result of strong regional collaboration.

Results

Since 1990, the single occupant vehicle (SOV) rate has declined by 0.4% per year. However, to reach the 25% goal by 2025, this rate needs to be doubled. In 2009, the City achieved a 1994 goal of no growth in vehicle miles traveled (VMT). The bus system has experienced a 300% increase in mode share, which is the greatest increase across all modes. By February 2010, transit ridership surpassed 37,000 trips per day. To further increase the transit ridership, a coalition of corridor governments, RTD, and CDOT are committed to providing \$300 million to provide a bus and bike dedicated lane along U.S. 36. Biking rates have increased 70%, and the walking rates have remained stable. To improve walking conditions, the City has added 530 linear feet of sidewalks to complete walking systems. Improving sidewalks and removing barriers have been other efforts in this regard. Travel time within the city has been steady over the years. (Transportation Division, 2012)

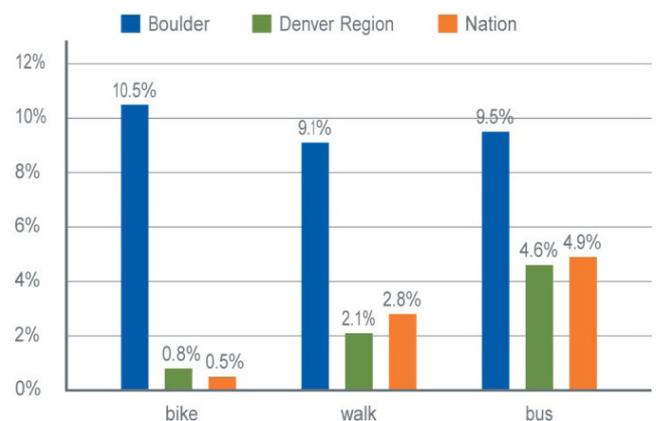


Photo 30: Modal share in 2010: Boulder's residents ride bus transit twice as much as the national U.S. average, bike over 21 times more than the national average and walk three times more than the average.

City of Boulder, bouldercolorado.gov

Transportation contributes 22% of the greenhouse gas (GHG) emissions of the city. In order to reduce that footprint, the Climate Action Plan designated funding to the Transportation Department. Most of the funds will be spent on the GO Boulder Business and Eco Pass programs (Transportation Division, 2012).

Lessons Learned

Boulder's Transportation Department **collaboration with other City departments has been key**. Boulder Comprehensive Plan provided the big picture goals and tied different plans together. Collaboration with regional partners is another factor contributing to the successful transit system.

The City of Boulder needs to find sustainable funding sources to progress towards the goals. Dependency on federal funding in regional plans delayed some key projects.

Integrating multiple transportation options and improving the reliability of the system have been an important factor to encourage the community to use alternative transportation. Bus frequency, access to bike, and pedestrian routes have provided convenient options for people who choose not to use their vehicles. Downtown pedestrian mall and walking-biking routes along Boulder Creek and the fourteen (14) tributaries provided pleasant and grade-separated access to move around Boulder. With the grade-separated greenways multi-use path system, most cycling trips are time competitive with the auto and bus.

Building political support has been an important aspect of Boulder's transportation planning. Extensive community outreach and education encouraged the citizens to choose alternative transportation. The city is assessing the progress frequently, which helps policy makers to make an informed decision.

Eco-Pass is critical to providing access and driving transit demand. A person with an Eco-Pass is 5 to 9 times more likely to use transit.

Managed, unbounded, and pay for parking is critical to developing the desired land use pattern, creating a level modal playing field and managing transportation demand. The city currently has four parking districts (Downtown, University Hill, University of Colorado, and Boulder Junction). Future plans are to expand the areas of the city with managed parking.

Land-use plays an important role in the success of multi-modal transportation. Boulder is planning to change the block scales, land-use, and street patterns on the east side of the city. The super-blocks pattern and lack of mix-use affects the community interest in walking and biking. Developing the Boulder Junction Transit Oriented Development on the east side of the city can be a catalyst for this change.

Marketing and education are pivotal strategies to change people's travel behaviours. Before 1989, the bus service primarily had served low-income residents and had not been considered a viable option by car owners. To encourage citizens in alternative transportation, the city implemented a marketing strategy to change social behaviour. After a few years of a successful campaign, the budget for marketing and educational initiatives has been nearly eliminated.

Replication

The Boulder model is replicable for many U.S. college towns. A young population is more likely to use alternative transportation, especially when a subsidised bus program is provided. When given a complete biking and walkway system, students are especially attracted to alternative transportation.

It is critical to test the city political climate for investing in alternative transportation. Building community consensus and bringing the policy makers on board is the first step in comprehensive transportation planning. Social marketing geared toward behaviour change can also help accelerate the process of shifting people out of their cars.

It is necessary to prioritise investment in visible changes to build community support. For example, providing a small scale Complete Street example may help the community to realise the value of access to such a system citywide.

Frequent monitoring and measuring are other tools that can increase the chance for success. It will help recognise the mistakes in early stages and build upon the success moving forward. Ongoing evaluation is also important in building and maintaining trust within the community.

Budget and Finances

The 2013 City of Boulder Plan approved a budget of \$13,522,500 for transportation (Staff, 2013). The local portion of the funding comes from a 0.6% sales tax, approved in 1967 by voters. The budget is also subsidised by federal funding, which is awarded for large infrastructure projects. Additionally, a small portion of the budget is money paid by developers in the form of Development Excise Taxes.

During the last ten years, the Transportation Fund decreased by 19%, with an estimated 38% drop in purchasing power. Knowing this, the City of Boulder set its expenditure priorities in 2011, increasing the percentage of the budget for operations, safety, and maintenance of current systems by nearly 20%. The city focused reductions and efficiency initiatives in other aspects, such as the city marketing efforts of GO Boulder and the reduction of transit services.⁴

In 2011, a bond against existing revenues was approved by voters, granting the city a one-time infusion of \$17 million to solve some urgent transportation infrastructure maintenance related issues, and \$9 million for new projects.

Currently, long-term funding deficiencies remain for the City of Boulder and have become a key challenge to implementing its 2012 TMP. The progressive decreases of federal and state funding have made the challenge even greater for the near future.

The funding allocation is reflecting the priorities for the local government. More than 75% of the enhancement budget is directed to the bike, pedestrian, and transit projects. Fifty-six percent (56%) of the Operation and Maintenance budget goes towards maintenance of the roads.

Sources

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Conclusion

It is evident that our cities **must** invest in promoting and implementing proper walking and cycling facilities, should we want to address the social, economic and environmental problems of urban transport. Merely building or painting cycle lanes and having footpaths from the leftover space do not show that the city is thinking or cares about pedestrians and cyclists.

We need to devote the same amount of time and expertise to promoting walking and cycling, as we do for planning and building motorways and other car infrastructure.

It is essential to understand that pedestrians need **SPACE** i.e. Safety, Priority, Accessibility, Comfort and Enforcement. The walking experience and the footpaths we build should reflect every element of SPACE.

For cycling to improve in our cities we need to provide cycle routes that are Connected, Direct, Safe, Comfortable and Attractive bicycle routes. Many cities tend to contemplate whether to provide a bicycle lane or a physically segregated bicycle track. A simple answer would be, if the speed of the other vehicles on the road is more than 30 kph then provide a physically segregated bicycle track with a minimum width of 1.5m for one way cycling and if the motor vehicle speed is ≤ 30 kph **and** if the volume of motor vehicles is less then provide a bicycle lane (refer to Box. 2 for more information).

It is understood that cities, due to lack of technical capacity, may not be immediately in a position to provide for walkable and bikeable communities. In order to address this, cities will need to invest time and resources on building the internal capacity of their staff, though partnering with various agencies working in the area of promoting walking and cycling. Public involvement in the whole activity is crucial for the success of the project. A consensus view on the benefits of walking and cycling will support the future development of non-motorised transport in cities.

Cycle Lane and Cycle Track Debate

Many cities spend a lot of time contemplating whether to implement a bicycle track or a bicycle lane. For those of use who need further explanation on what a cycle track and a lane is, here is our definition.

Cycle Track: Is a physically segregated bicycle path. The segregation is both from the motorised vehicles and from pedestrians. It is suggested that the absolute minimum width of a cycle track is 1.5 m which allows only one way bicycle flow, while a desirable is a 3.0 m two way track. It is suggested to build cycle tracks on roads where the motorised vehicle speeds are more than 30 km/h, irrespective of the volume of cyclists. Similarly, a 3.0m track is essential when there is high volume of cyclists.

Cycle Lane: A cycle lane is space dedicated for bicycles on narrow roads. Cycle lanes are not physically segregated and are usually kerb-side. In some cities cycle lanes are painted/coloured to differentiate with the regular carriageway. The typical width of a cycle lane is 1.2m on a narrow road. Cycle lanes are not suggested on road with high traffic volumes and speeds. A cycle lane that is wider than 1.2 m can be mistaken for parking by vehicles and can be easily encroached upon.

In conclusion, it is suggested:

Cycle Tracks when the motor traffic volume is high and/or traffic speed is > 30 km/h.

Cycle Lanes are suggested when road space is inadequate and traffic volume on the road is less and traffic speeds are ≤ 30 km/h.

Suggested Resources

1. Institute for Transportation and Development Policy (ITDP): <http://www.itdp.org>
2. EMBARQ: <http://www.embarq.org>
3. GIZ's Sustainable Urban Transport Project (SUTP): <http://www.sutp.org>
4. Clean Air Asia (CAA): <http://cleanairasia.org>
5. Partnership on Sustainable Low Carbon Transport (SLoCaT): <http://www.slocat.net>
6. FIA Foundation: <http://www.fiafoundation.org>
7. Reinventing Urban Transport: <http://www.reinventingtransport.org>
8. Sustainable Cities Collective: <http://sustainablecitiescollective.com>
9. World Streets: <http://newmobilityagenda.blogspot.in>

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