Traffic Calming in Three European Cities: Recent Experience

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ABSTRACT

European experience can be useful for cities seeking to improve and expand traffic calming programs. This research summarizes recent traffic calming experience in Zurich, Vienna, and Munich. It is based on interviews with transportation professionals and literature review. It describes recent projects and draws general conclusions from these projects.

The research findings were consistent for all cities. First, traffic calming has been well integrated into the general transportation planning process. It is no longer a special case and is intended to help meet traffic reduction goals.

Second, adequate funding has not been available for traffic calming. Funding shortages have forced cities to implement less costly techniques than ideal and have reduced their ability to implement more effective areawide programs. Therefore, cities are searching for less expensive ways to implement traffic calming and are linking traffic calming with other better funded programs (e.g. street resurfacing).

Third, the cities are working closely with the community on implementation of traffic calming projects. They work proactively using such techniques as partnership programs, citizen involvement, and expert commissions. This process has led to compromise on the policy and project level, but has enabled the programs to progress. An example of compromise is replacing parking taken to implement traffic calming with underground parking, this is controversial and requires careful balancing of interests.

Finally, a new generation of projects including arterial street narrowing is challenging some ‘obvious’ traffic engineering ideas. Additional research is needed on these ideas.

1. INTRODUCTION

European cities have a long experience with traffic calming and can therefore provide lessons to cities seeking to improve and expand traffic calming programs. This research summarizes recent traffic calming experience in three European cities: Zurich, Vienna, and Munich. It is based on interviews with transportation professionals and literature review.

Many research studies and books have been written on traffic calming. These range from technical reports oriented towards professionals (1), (2) to innovative and unconventional ideas for activists (3).

Given such a large literature, the precise definition of traffic calming is elusive. (1) The Institute of Transportation Engineers has adopted a definition that focuses on physical measures, ‘Traffic calming is the combination of mainly physical measures that reduce the negative effects of motor vehicle use, alter driver behavior and improve conditions for non-motorized street users.’ (4) However there are many measures beyond physical changes that can be used to achieve these goals, and furthermore there are other goals, such as improving the environment for non ‘street users’ (e.g. residents). This research uses a broad definition of term traffic calming, including all types of measures designed to reduce the impact of motor vehicles on neighborhood livability.

The research goal was two-fold, first to describe current traffic calming projects in the three cities, and second, to draw some general conclusions based on these projects. The project descriptions are intended to

provide practitioners with ideas for traffic calming, while the conclusions are intended to identify policy issues and identify areas for additional research.

The three cities chosen for this research: Zurich, Munich, and Vienna are all considered to be extremely livable cities and can be characterized as having excellent public transportation and urban design.

2. INTEGRATION OF TRAFFIC CALMING INTO TRANSPORTATION PLANS

All three cities examined in this research have integrated traffic calming into their general transportation planning process and believe that traffic calming can have a measurable impact in improving transportation conditions as well as livability. This section summarizes general transportation planning in the three cities with an emphasis on how traffic calming has been integrated into the plans. One objective of the summaries is to illustrate the comprehensive scope of these general transportation plans.

This section also outlines a bit of history concerning development of these general transportation plans. Interestingly, in all three cases, one incentive for increasing focus on traffic calming was major external force. This is consistent with research showing that making fundamental changes to the guiding goals of transport policies often depends on opening a 'macro policy window' which usually only opens by external forces. (5)

Zurich

A key event for Zurich's transportation policy was the defeat of ballot measures designed to construct new underground rail transit systems in 1962 and 1973. Environmental groups opposed the 1973 measure on the grounds that building an underground Metro would allow removal of streetcar tracks increasing vehicle capacity on the streets. Following the 1973 defeat citizens voted to improve the existing surface transit system with a comprehensive transit priority program including complimentary traffic calming measures. (6)

During the 1980s as the transit priority program was being implemented, Zurich recognized that its streets could simply not continue to accommodate more vehicles. Therefore, in 1987, the City Council approved the following five transportation policy goals:

- Promote public transport.
- Reduce motor vehicle traffic.
- Channel motor vehicle traffic and restrain motor vehicle traffic in residential areas.
- Reduce parking for commuters.
- Guarantee the environment-friendly mobility of cycling and walking. (7)

These goals recognized that even the carrot of improved public transit and environmentally friendly transport modes cannot alone protect the city's quality of life – measures designed to reduce motor vehicle traffic would be needed as well. These measures included a systematic traffic calming program, traffic reduction projects, and a reduction in commuter parking.

In May 2001, Zurich's City Council passed a new 'Mobility Policy' designed to encourage new sustainable economic development and to mitigate damage caused by earlier development. The policy was supported by the following five guidelines:

- Manage mobility to optimize a multi-modal transportation system.
- Develop and support new transportation innovations (e.g. communications replacing transportation, or improved city logistics).
- Complete infrastructure network with adequate mitigation and taking a wholistic view of transportation capacity.
- Charge true costs for transportation service
- Use a 'New Urban Mobility' approach to establish a social contract for citizens and businesses with respect to transportation.

Zurich also adopted 18 sub-strategies to achieve these goals including linking land use and transportation, mobility management, freight transportation, inter-government cooperation, financing, as well as traditional mode-based strategies (i.e. public transit). (7) The plan's guidelines and strategies continue and extend the city's commitment to traffic calming.

Vienna

Vienna's long-range transportation policy takes a broad approach to transportation planning including support for traffic calming and other innovative programs. The opening of the Europe's Eastern countries and future accession of most of these countries into the European Union has caused a significant change for Vienna

transportation planning. Before 1989 Vienna was at the end of the Western European peninsula; it had very little through traffic. Now, Vienna is once more the cross roads of major roadway and railroad corridors in both the North –South and East-West directions. This has created the need for significant infrastructure investment and policy development.

In 1994, the City of Vienna approved a new master plan for urban and regional transportation called the 1994 General Traffic Concept. (8) This plan called for a reduction in private vehicle mode split for working day trips within the City of Vienna from 37% in 1990 to just 25% in 2010. (9)

In 2002, to address the need for policy guidance at the European Union and National levels, the City issued a new position paper (10) outlining its transportation priorities, reviewing progress on the 1994 plan, and recommending that a revised general transportation plan be prepared. This document recommitted the city to the 1994 plan's principles, specifically:

- Sustainable Mobility – Social, environmental, and safety should be priorities in transportation planning.
- Efficiency – External costs and cost/benefit analysis should be part of the planning process.
- Acceptance – Transportation planning requires informing and involving the public and interest groups.
- Co-Operation – The city and region must work together with the private sector to solve transportation problems.
- Innovation – New ways of solving transportation problems including funding, participation, communications substitution, technology, and infrastructure should be encouraged.

Of particular interest for traffic calming are objectives to reduce the private vehicle space consumption and pollution by reducing use of private vehicles and encouraging a shift to environmentally friendly modes.

The position paper recommended that a more detailed transportation analysis be made to update the 1994 plan, and this planning process is currently underway (scheduled for completion in 2003). As part of this planning process innovative measures designed to better link transportation and land use planning are under consideration, but the Vienna region is facing a situation similar to many U.S. cities with increasing suburban development over which the city has no control, and increased commuter traffic on new roadways built to facilitate through traffic.

Munich

The genesis of Munich's modern transportation system was the 1972 Olympic games. In preparation for the Olympics, Munich constructed an extensive underground U-Bahn (metro) and S-Bahn (commuter rail) that today forms the backbone for the city's excellent public transportation network. Following completion of the U-Bahn many of the inner city's existing streetcar and bus lines were removed and streets redesigned to provide greater vehicle capacity. (One of Munich's current planning efforts is to rebuild selected streetcar lines; this is proving to be as hard in Munich as in U.S. cities.)

During the 1970s and 1980s, Munich began systematically improving its bicycle route system and introducing traffic calming measures. The city's interest in biking and pedestrian friendly neighborhoods has continued to grow over the years and Munich has made improvement of bike and pedestrian facilities a key point in its new transportation plan. This plan calls for reducing automobile trips from today's 35-40% to 30-35% and increasing bike trips from 10-15% to 15-20% while the public transit's share and walking share remains at current levels between 25-30% and 20-25% respectively. (11)

Munich's comprehensive development plan, *The Munich Perspective* presents the city's guiding development principle: 'compact, urban, green' – compact to use urban land efficiently, urban to provide an attractive mix of homes, jobs, shops and leisure facilities, and green because an attractive arrangement of open spaces and vegetation improves the natural balance and enhances the quality of urban recreation. (12)

Specific steps taken to achieve this vision include City Council approval of a citywide bicycle network (1993) that is currently being completed as well as adoption of principles for a pedestrian friendly city (1996). These principles include designing streets and squares with pedestrians in mind, improving crossing points along main roads and providing new and convenient routes for pedestrians only. Environmentally friendly transportation is a key element in the city's Transportation Development Plan, designed to ensure mobility in the city in the long term and tangibly reduce the undesirable effects of traffic. (12)

3. TRAFFIC CALMING IMPLEMENTATION: EVALUATION AND PUBLIC INVOLVEMENT

Traffic calming projects are often controversial and most government agencies are controversy adverse. Thus the question of how to implement traffic calming is particularly important. This research found that all three cities were implementing much more comprehensive public involvement programs for traffic calming projects at all stages from planning to implementation (for example, all the projects outlined in Section 5 included significant

public involvement). Three particular strategies of interest identified in this research were the use of commissions in Munich and Vienna to evaluate traffic calming techniques and programs, a guided public involvement program in Munich, and the use of partnerships in Munich.

Munich's 1994 Traffic Calming Policy Evaluation

In 1985 Munich's City Council passed a resolution specifying that traffic calming should be the basis for transportation planning at all levels of consideration. In 1994 the City Council reaffirmed that statement following an analysis of the traffic calming program. While traffic calming remained a high priority, the analysis identified several problems and recommended improvements. (13)

To start, the analysis recognized the contradictions in the traffic calming program, for example while many people wanted traffic calming in their neighborhoods, automobile use was still increasing, and better transportation was needed for the city's economic health. Furthermore, the cost of traffic calming measures was increasing while the funds available were decreasing. Given these conditions the analysis recommended a program that worked at developing compromise solutions on the neighborhood level.

The City Council also recognized that many negative effects of traffic were caused by high speeds, and therefore recommended that the city's Tempo-30 program (see below) be continued and called for increased programs to reduce motor vehicle speeds in the city (including a public awareness program, increased enforcement of speed limits, and physical measures in especially critical areas such as near schools). They also specified that new traffic calming projects focus on neighborhood streets with large volumes of through traffic and improving safety for pedestrians and bicyclists (especially children, seniors, and disabled). These projects should be easily removed in the future, and have clear neighborhood support. Finally they called for development of traffic calming measures for arterial streets.

Vienna's Fachkommission für Verkehr (Ohrwaschel Kommission)

Vienna organized an expert commission in 1994 at the height of a public controversy over implementation of traffic calming. This commission, called the Fachkommission für Verkehr (humorously known as the Ohrwaschel Kommission since corner widenings look a bit like ears – Ohr is ear in German) included technical experts, organizations (Labor Unions, Chamber of Commerce, Austrian Transportation Club, Bicycle Organization), and city administration (Urban Development and Planning, Road Management and Construction, and Traffic Management and Organization), as well as – importantly – opponents to traffic calming (several automobile clubs). (14)

The commission completed a detailed review of the various traffic calming measures used in Vienna, including their safety, effectiveness, impacts, public acceptance, and costs. Following the analysis, the commission recommended that approximately 95% of the measures be approved and rejected the others. Having opponents to traffic calming serve on the commission helped increase its credibility and served as a learning experience for opponents.

Munich's Neighborhood Transportation Planning Program

Munich has started an innovative planning effort designed to identify and solve transportation problems on the neighborhood level. (15) Two interesting methods used in the Munich program are problem identification and analysis.

In terms of problem identification, Munich used the traditional meeting, mail survey and Internet approach, but also organized a program of tours through the neighborhood to help in the process. The purpose of the tours was to help better identify problems for particular transportation modes and demographic groups by enabling planners and members of the public to jointly experience the neighborhood transportation network. The following tours were held:

- Public transit (bus).
- Walking.
- Roller-skating.
- Bicycle.
- Children and parents.
- Seniors.

The tours were organized and led by planners from the consulting firm hired to complete the neighborhood transportation study. They were publicized as a fundamental part of the study effort including being described in the public mailing and Internet site (http://www.muenchen.de/plan/monaco/), as well as being mentioned at the public meetings. Transportation planners participated in the tours and recorded suggestions, comments, and

problems identified by the participants. This information was incorporated into the study in the same manner as comments obtained using more typical means (e.g. public meetings).

Over 500 specific suggestions were obtained using the combined process of public meetings, Internet, and tours. These suggestions then were analyzed and appraised by the citizens to develop a list of recommended measures. The real benefit of public input programs is that citizens generally have a better idea of how the transportation system is actually being used than the ideal world often imagined by planners. When planners are open to understanding the problems citizens identify it can help improve the quality of solutions.

Given the large number of suggestions, they were organized into four different categories: general recommendations for good local transportation, recommendations relevant to the entire district, recommendations relevant to a specific sub-area of the district, and finally, other recommendations. By organizing the recommendations into categories it was possible for citizens to more efficiently and effectively evaluate and discuss them in the public forums. (15) The study is currently being completed and an implementation plan is being prepared.

The second interesting aspect of Munich's program was that it attempted to teach the citizen participants a bit about various strategies, tradeoffs necessary and technical issues in transportation planning. This was done through presentations (e.g. a slide-show presentation on pedestrian improvement measures) as well as through the participation of technical staff on the tours and in the citizen forums (planners provided immediate feedback on citizen generated ideas and questions). Providing 'real time' feedback gave citizens a more complete understanding of the problems and solutions that are possible, which in turn helped stimulate thinking and creativity.

A major emphasis of this educational effort was communicating the tradeoffs involved in implementing different measures, for example, providing more space for bicycles means less space for another mode.

The general recommendations raised by the citizens taking part in this effort were: improved parking management (to address the lack of parking and illegal parking), longer green time for pedestrians at traffic signals, better orientation signage, more space for pedestrians and bikes (including opening one-way streets in Tempo-30 zones for two-way bike traffic), barrier-free mobility, speed limit enforcement, and a public relations effort to encourage more consideration in travel behavior. (15)

Munich's Partnership Program

In addition to working with citizens and interest groups on a neighborhood level, Munich has also worked in partnership with businesses and other organizations to solve transportation problems on a citywide basis. For example, the "Inzeller Kreis" was founded with the target of co-operatively improving the traffic situation in the congested urban areas of Munich, and follows the motto "solving traffic problems together". Members of the group include the BMW Group, Munich city government, Bavarian government (the state), Munich technical university, as well as economic organizations. (16)

The group's key policies can be considered environmentally friendly although they represent a clear compromise. For example, one policy states that in locations where traffic calming is put into place, traffic should be diverted to main streets. This is a good illustration of compromise because a pure environmental position might be to simply forget about the diverted cars, while a pure motorist position might be to never allow traffic calming.

One interesting policy seems to sum-up the urban transportation problem, 'the share of automobile transportation should shrink as you get closer to the center of the city'. The policies also support parking management programs, priority for public transit, cooperative transportation management, and better urban goods movement programs. Making businesses and organizations part of the transportation improvement process has helped build understanding and support for implementing traffic calming programs in Munich.

4. FINANCING TRAFFIC CALMING

Research from the United States has found that funding constraints restrict traffic calming in both scope and strategy. According to this research, cities are forced to implement inexpensive strategies even when other (more expensive) strategies would work better, and that cities must address traffic calming on a spot-fix basis rather than through more costly but potentially more effective neighborhood or district plans. (16)

The three cities examined in this research also identified funding as a problem for traffic calming programs. Funding has become especially critical, as economic conditions in many European countries have deteriorated during the last few years. Two ideas identified in this research for addressing the funding program are: an experimental program for low-cost improvements in Zurich (which was unsuccessful), and coordinated implementation of traffic calming projects with other better funded programs.

Zurich's Tempo 30 Zone Street Marking Experiment

An important traffic calming measure throughout Europe is the Tempo 30 program. This consists of setting a speed limit of 30 kilometers per hour (about 19 miles per hour) in residential areas. Many neighborhoods in Zurich, Vienna, and Munich are Tempo 30 zones. Zurich has just started a comprehensive monitoring program to assess the effectiveness of the Tempo 30 zone program on vehicle speed and mode (e.g. bicycle counts).

The most effective way of enforcing Tempo 30 zones (i.e. insuring that vehicles remain under the speed limit) is introducing physical traffic calming measures such as street narrowings and speed humps, but these measures are expensive and take time to implement. Therefore, Zurich started looking for a simple and inexpensive way to indicate Tempo 30 zones and reduce vehicle speeds.

The city developed painted pavement markings to designate the entrance to a Tempo 30 zone and Tempo 30 intersections. The Tempo 30 zone entrance consisted of wide lines painted across the street in a triangular plan with less distance between the lines as they enter the Tempo 30 zone (communicating the idea: slow down). The Tempo 30 intersection markings included the same wide lines as they approach the intersection and a painted circle in the intersection's center.

The Tempo 30 markings were introduced in several areas of the city but unfortunately they proved to be quite confusing. Drivers were unsure if they were supposed to treat the painted circles as actual traffic circles or if the circles were just there to remind drivers to go slowly. Given the confusion the federal government evaluated the pavement markings and determined that only standard pavement markings should be used and that the preferred means for identifying Tempo 30 zones are physical traffic calming improvements. Given this decision, Zurich must now remove the painted markings.

Coordinated Implementation of Traffic Calming Improvements

A commonsense, but often unused strategy for reducing the project costs is to implement several different projects concurrently. A good example is repairing underground utilities before repaving a street. Not only is this strategy extremely cost effective, but it also reduces the negative impacts of a project. All three cities surveyed in this research attempt to coordinate physical improvements in this manner.

In Vienna, traffic calming improvements are implemented as part of the City's regular roadway maintenance program. Thus, when streets are scheduled to be re-paved or rehabilitated, engineers add traffic calming measures to the design and these are built concurrently with street construction reducing costs and impacts. Often city departments responsible for street rehabilitation are so focused on the needed improvements that they are not motivated to add traffic calming. By linking funding for street rehabilitation to implementation of traffic calming, it is possible to provide the extra encouragement for otherwise reluctant city departments.

Zurich has also coordinated implementation of traffic calming improvements with other transportation improvements programs (as outlined in the projects described below). Furthermore, Zurich has used this comprehensive approach to improving the transportation system to implement projects that might otherwise be unpopular. For example, implementing a traffic calming project that reduces traffic through a neighborhood (viewed by residents as positive) concurrently with a transit priority project that reduces parking (viewed as negative). (6)

5. TRAFFIC CALMING PROJECTS

This section describes some recent traffic calming projects identified in the research effort. The focus is on non-traditional aspects of traffic calming: arterial streets and parking.

Traffic Calming on Arterials and Squares

Historically, the main concern of traffic calming has been to reduce the impacts of traffic on residential neighborhoods. Increasingly however cities are considering traffic calming programs for other parts of their transportation networks such as arterial streets and public squares. Often these are neighborhood commercial streets or centers, and an important goal is economic – improving the environment to increase the attractiveness of the area's shops, cafes, and businesses. However, it should be emphasized that the economic benefits of traffic calming are difficult to accurately measure and evaluate since they depend on factors such as general business conditions, competition, and the difficulty in collecting economic data. Furthermore, unless carefully planned, the construction period has negative economic impact on existing businesses.

Traffic calming for arterials is more complicated than for residential streets since arterials carry more traffic and serve more functions. In some cases major arterials or squares have been simply closed to traffic, but often that strategy is infeasible for political or practical reasons. (Although in some cases streets have been closed to traffic after first being subject to traffic calming – once people get used to the idea that reduced vehicle traffic does not mean lost business.) Six interesting arterial traffic calming projects identified in this research are described below.

Zurich's Schaffauserplatz Reconstruction

Zurich has recently undertaken a program to improve the livability in its major squares while maintaining or improving their transportation functions. Squares were selected for this program superimposing a map of arterial streets over a map of the city's neighborhood shopping districts. A good example of the square reconstruction process is at Schaffhauserplatz, a square at the intersection of two arterials, several neighborhood streets, four streetcar lines, one bus line, several bike routes, in a neighborhood commercial area.

Zurich's planners took a comprehensive and multidisciplinary approach to rebuilding Schaffhauserplatz. The project consisted of improving operation of public transit through the square by re-locating transit stops to more convenient locations, fine-tuning transit priority techniques as well as renewing streetcar track and signaling systems. Traffic volumes were maintained even while reducing the amount of vehicle space through careful channelization and traffic signal design. Interestingly, a pedestrian underpass was removed due to lack of use, personal security reasons and because Zurich has a policy stating that pedestrians should be able to cross streets at grade.

Traffic calming techniques including creating cul-de-sacs and building traffic tables to reduce and slow-down traffic entering the neighborhood streets. Better bicycle and pedestrian connections were created through the square. Finally, sidewalks were expanded and many amenities such as trees, fountains, and benches were added to improve the area's livability. The Schaffhauserplatz project included a complete public involvement program and was carefully coordinated between various different Zurich city departments that shared in the project funding.

Vienna's Public Area Improvement Program

Vienna has had a long running program to improve the city's public squares and neighborhood commercial streets. The publication: Urban-Space-Experience: Organization of public areas in Vienna, describes these projects in text and illustrations. Interestingly this document summarizes the quantitative decrease of street (traffic) space and increase in pedestrian and green space for each project. Vienna has approached the problem of improving these areas in a manner similar to Zurich. Important similarities include: very careful traffic engineering to ensure that the transportation system continues to function, high quality urban design, and attention to details. Many of the squares include improved access to public transit as well as underground parking; in fact many of the projects were undertaken as part of public transit projects such as construction of new U-Bahn extensions. These projects are a good example of using a coordinated approach to reduce the cost and impacts of transportation projects. (18)

Seftigenstrasse Arterial Traffic Calming Project

The Seftigenstrasse project in the Wabern area of Bern is a good example of an arterial traffic calming project. Here, a neighborhood commercial street with high traffic volumes (approximately 22,000 vehicles per day), a streetcar line, pedestrians and bicyclists was reconstructed to be both more efficient and more livable. The project implemented many traffic calming techniques including traffic circles, a center median, narrowed traffic lanes, widened sidewalks, and careful transit station placement. Figure 1 presents before and after photos. Before and after studies show that public perception of the area has significantly improved, the environment has been improved, and transportation conditions for public and private transport work well. Traffic moves more slowly through the area than before, but more efficiently. Traffic volumes and travel times have remained approximately the same before and after the project.

A key feature of the Seftigenstrasse project's success was construction of the center median and adoption of shared (public transit and private traffic) lanes. These features made it much easier for pedestrians to cross the street and consequently made the area more attractive for shopping. Pedestrian traffic increased by 11% and bicycle traffic increased 56%. (19)

Franklinstrasse Arterial Traffic Calming Project

Franklinstrasse is a commercial arterial street in the City's Oerlikon area. Zurich's plan is to rebuild the Franklinplatz intersection – currently an intersection with six streets by widening sidewalks, adding channelization, improving the pedestrian environment, and adding traffic calming improvements (speed tables, corner narrowings). The plan also includes a median similar to the Seftigenstrasse project through the intersection area that will reduce the width of Franklinstrasse, provide a pedestrian island, and prevent motor vehicles from crossing Franklinstrasse.

In addition to these improvements, the roadway segments leading to and from Franklinplatz will be reconstructed with much narrower lanes. The two-lane street will be narrowed from the current 8 meters wide (two vehicle lanes 2.6 meters wide and two bike lanes 1.4 meters wide) to 6.5 meters wide. In the new layout, bicycles will share the traffic lanes with motor vehicles. The street will not be painted with a dividing line

allowing motor vehicles to safely pass bicycles when on-coming traffic allows; when there is on-coming traffic, vehicles must remain behind the bicycles. The idea is that having bicycles share lanes with vehicles will slow down traffic. A similar program is being implemented on other city streets.

Zurich Tram Stop Reconstruction Program

During the 1980s exclusive transit lanes were built on many of Zurich's arterial streets as part of the city's comprehensive transit priority program. (6) The typical cross section is two exclusive transit lanes in the center and two mixed traffic lanes on the outside. Tram stations are raised islands located on the outside of the exclusive transit lanes.

In the mid-1990s, Zurich began rebuilding tram stations by extending the sidewalk into the mixed traffic lanes thereby forcing private vehicles and transit to share one lane through the station. This means that when a tram is stopped at a station, other traffic must wait for it to leave before proceeding. This design has made the stations more attractive and safe for passengers (by eliminating the need to cross the street to reach the boarding area) as well as helped calm traffic on the arterial. The design has not caused an increase in motor vehicle accidents. The key to this success is that the conflict zone (i.e. where private vehicles merge into the shared lane) is clearly marked and understandable to motorists. (20)

Transit Priority on Narrowed Arterials

It is also possible to narrow an arterial segment (as opposed to only narrowing at the station) with two exclusive transit lanes and two mixed traffic lanes and still provide priority for transit by careful placement of traffic signals. Zurich's Limmatquai and Bern's Seftigenstrasse both have used this technique to widen sidewalks for pedestrians, shopping, and cafes. Figure 2 illustrates the transit priority being provided by a traffic signal on Zurich's Limmatquai. The system works by placing a traffic signal at the point where the exclusive transit lane merges with the mixed flow lane. When a tram approaches this point, the traffic signal turns red for vehicles in the mixed traffic lane until the tram has gone ahead. (6)

Parking

One of the largest sources of opposition to traffic calming measures is the removal of parking spaces. Residential parking in center cities one of the best examples of over consumption of scarce goods, but this is hardly news for transportation planners, and this theory does not placate neighborhood residents angry about the loss of parking.

An interesting aspect of parking loss is that often there is a higher 'effective' stock of parking spaces than officially recognized. For example, a major problem with corner sidewalk widenings is that this space is being used for illegal parking. Most city residents are quite familiar with the problem of cars parking too close to the corner and-or on the tangent of rounded corners. Residents often are complaining about the loss of these 'illegal' spaces as well as legal spaces.

All interesting and attractive cities have parking problems; often one key to improving urban transportation conditions is to control parking. All three cities considered in this research have introduced parking control programs in an attempt to reduce congestion, encourage environmentally friendly forms of transportation (e.g. public transit, bicycling, walking) and to increase livability.

Residential Parking Programs

The main way of controlling parking is introduction of residential parking zones where only residents can park for an unlimited amount of time. Non-residents generally have time limits (two-hours) and metered parking in commercial areas. Many cities also use pricing to discourage all-day parking in center city parking garages and impose limits on the number of parking spaces that new development projects can provide. Zurich implemented a very successful parking control program in the 1980s that reduced commuter parking and introduced residential parking throughout the city. Many people identify the lack of parking as one reason that they use transit or other environmentally friendly modes of transportation. (6)

Parking control was a key measure recommended in Vienna's 1994 General Traffic Strategy and it has been implemented in most of the city's inner districts. The parking control program has been identified as one of the most effective instruments at helping to reduce the motor vehicle mode split for commuters to the center city (the General Traffic Strategy has decreased motor vehicle mode split by 4% while increasing public transit and biking mode split by 2% each). The only problem with parking control in Vienna is that the city has introduced it in all the most obvious areas (i.e. center city districts with good public transportation) and so new innovations will be required to continue the program's success. (21)

In Munich the partnership group (described above) has worked together on is introduction of a parking management program for the Altschwabing, Schwabing-Mitte, and Lehel districts. This program divides the street parking into zones for residents, short-term users, and a mixed parking. Residents can obtain a yearly

permit that allows them to park in the residential or mixed zones. Visitors must pay to use the mixed zones or the short-term parking zones (residents must also pay to use the short-term zones). While parking management programs are known to be effective, they are generally difficult to implement, by working together with the private partners (including the University, which is located in Schwabing) the city was able to implement this parking program.

Underground Parking Garages

Given the controversy over removing neighborhood parking, some cities have chosen to compromise and build underground parking to replace parking that is taken for traffic calming and other livability projects. Building underground parking garages as part of a traffic calming effort is controversial. From the environmental perspective simply eliminating parking without replacement would be the optimum policy. However, if the choice is between implementing traffic calming on the surface with replacement parking underground (paid for through parking revenues) or keeping the status quo, many would choose to compromise and build the replacement parking.

Zurich was quite successful at simply removing parking from its center city through the 1980s, but a backlash developed and forced the city to adopt a 'Parking Compromise' that requires replacement of any parking that is taken for traffic calming or other purposes on a one-for-one basis. Vienna also has a program of constructing underground neighborhood garages and then using the space above these garages to create playgrounds and open space with limited residential and delivery access (for example Schlesingerplatz in Vienna's Josefstadt district).

Other European cities (e.g. Paris) have taken a similar approach to reducing the impacts of automobiles in cities, building underground parking and introducing traffic calming with open space on the surface level. These underground parking facilities can also be designed to reduce impacts of automobiles on neighborhoods by carefully designing entrances and exits to feed traffic on to the major arteries rather than neighborhood streets.

Two key considerations in building underground parking are cost and safety. The cost issue is easy to explain, underground construction is expensive. Many cities, including Vienna, have funded neighborhood parking garages using parking meter fees, residential parking fees, and parking ticket revenues. In terms of safety, while European cities are reasonably safe, even there underground parking has been carefully designed with personal safety in mind.

6. SUMMARY AND CONCLUSIONS

The main research findings were consistent for all cities. First, traffic calming has been well integrated into each city's general transportation planning processes. Traffic calming is no longer a special case (in fact several cities are counting on traffic calming to help meet overall goals for traffic reduction).

Second, cities are searching for less expensive ways to implement traffic calming. The cost of building the standard traffic calming devices (such as traffic humps, corner narrowing, and traffic circles) can be high and low cost solutions are important to provide traffic calming to many different areas of the city quickly. Importantly, cities examined in this research have been successful at linking implementation of traffic calming with other (better) funded programs (e.g. street resurfacing).

Third, all the cities have adopted a much more consultative process when working with the community in implementation of traffic calming projects. Cities work pro-actively with citizens at all stages of the process. Three interesting public involvement techniques identified in this research include:

- Citizen Involvement – Neighborhood forums, walking tours, technical assistance.
- Expert Commissions – Objective commissions organized to evaluate traffic calming techniques and programs.
- Partnership Programs – Government working with the private sector and other interest groups to implement traffic calming programs.

These consensus-building efforts all include an element of education and significant elements of compromise.

Compromise is very important in the implementation of traffic calming projects in all three cities. Successful projects are the result of compromise on all levels, from policies to projects. The program of building underground parking to replace parking lost implementing traffic calming or open space programs represents a clear compromise. Removing cars from the surface provides real traffic calming and livability benefits, even if not as environmentally beneficial as simply eliminating the cars.

A fourth lesson is that in some ways we have reached a point in traffic engineering where 'obvious' solutions are no longer true. Some examples include reducing vehicle space (e.g. narrowing arterials) and maintaining traffic volumes; mixing transit and vehicles at tram stops without increasing accidents; and,

removing exclusive transit lanes, but maintaining transit priority. What is important about these examples is that while they have minimal impact on traffic they provide enormous benefits for other users such as pedestrians, bicyclists, residents, and businesses on the street.

This last point brings up an important area for additional research. There is clearly a need for more formal study on the traffic impacts of these types of non-intuitive findings. For example, how narrow can an arterial be made and still have it function effectively? Another area for more research is how to obtain the funding needed to implement traffic calming on a larger scale.

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Figure 1: Seftigenstrasse Arterial Traffic Calming Project: Before & After
Source: IKAOe und GIUB Universitaet Bern.

Figure 2: Transit Priority on Narrowed Arterial Provided by Traffic Signal
Source: Andrew Nash