

APPENDIX C

**UNIVERSITY OF VICTORIA - BICYCLE STRATEGY:
INTEGRATING BICYCLES AND CONFLICT MANAGEMENT
(MOBYCON CONSULTING) - MEMORANDUM**





University of Victoria - Bicycle Strategy: Integrating Bicycles and Conflict Management



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1 Introduction

The University of Victoria is seeking to explore how to best integrate bicycles into their campus. This task requires a multitude of approaches, including, but not limited to how to manage interactions with other modes. This challenge encompasses how bicyclists interact with each other, pedestrians and motor vehicles across the campus.

Due to the layout and traffic environment at the University of Victoria, the opportunity for conflict and complexity of interactions between pedestrians and cyclists is of primary consideration. While conflicts with vehicle traffic still pose by far the greatest threat to safety, these interactions are often less complex, and more easily dealt with through traditional engineering approaches. This paper seeks to explore the management of bicycle/pedestrian conflicts and how design can be employed to achieve desired results; though many of the principles are directly derived from, and applicable to traffic environments that include motorized vehicles.

The underlying framework to be employed in exploring how to manage conflicts is Sustainable Safety. Developed in the Netherlands as a systems approach to traffic safety, Sustainable Safety sets out a series of principles upon which a safe traffic system should be built. Fundamental to this approach is a focus on human behaviour and design-oriented solutions.

Behavioural dynamics between cyclists and pedestrians will be explored to help build an understanding of their interactions. This relationship is of primary importance to designing a safe and effective environment for both modes. Unlike motor vehicles, pedestrians and cyclists are much more fluid in how they move through space; therefore a revised view on conflicts is required.

With a fundamental understanding of the framework of a safe traffic system, as well as how pedestrians and cyclists interact, a spectrum of conflict management strategies will be put forward. As not all environments demand the same or even similar treatment, a series of strategies is required in order to develop context sensitive solutions. This set of solutions is followed by decision guidance on which strategy is most appropriate for a given context.

The final component is a set of design tools to help achieve the desired results. As traditional traffic control devices are often less effective between cyclists and pedestrians, design tools play a critical role in managing behaviour in a clear and effective manner.

2 Sustainable Safety

2.1 Ensuring a safe, inclusive and comfortable traffic system

The goal of a traffic system is to provide safe and comfortable access and movement for road users. In order to achieve this, there are two underlying principles that should be accepted:

- It is unethical to accept a system which facilitates the injury of users
- It is unethical to accept a system that excludes users, whether because of a disability or choice of mode, be it by bicycle, transit, car, walking, skateboard, moped etc.

In attempts to achieve this, cities and countries all over the world have embraced *Vision Zero* and similar initiatives focused on eliminating traffic-related fatalities. In the Netherlands, a similar philosophy was adopted and developed into a set of policies and guidance in the early 1990's named 'Duurzaam Veilig' (literally translated as sustainable safety) (SWOV, 2013). This comprehensive, systems approach is garnering increasing levels of interest as it is introduced to international audiences.

The five basic principles that underpin Sustainable Safety are:

1. **Functionality:** Every street has an identified primary function (ex: local access road, main shopping street, regional highway, etc.).
2. **Homogeneity:** Differences in speed and mass should be minimized between users that share space.
3. **Recognizable:** Users should be able to easily recognize and understand the function of a road and the behaviour expected of them and others.
4. **Forgiving:** Everyone makes mistakes. The system should accommodate mistakes in a way that does not result in severe outcomes.
5. **Awareness:** The ability to assess one's own capacity to operate in the environment.

2.2 A People-centric Approach

At its core, Sustainable Safety is a people-centric approach. Currently, many traffic environments suffer from a multitude of different classes of streets, roads, stroads, paths and trails. The existence of too many typologies creates difficulties in recognizability for users.

In order to prevent this, three main types of road were identified, each with an identified function and corresponding form.

- Through (focus on flow)
- Arterial (flow midblock, exchange/access at intersections)

- Local (focus on access)

In this classification, only the second and third type should be found in the build up urban area; through routes are mostly highways and should be autonomous and separated from the urban fabric surrounding it.

This classification dictates much about the relationship between vehicles, bicycles and pedestrians. On through routes, bicycles and pedestrians are forbidden. On arterials they might be present but each on their separated infrastructure, while on local streets vehicles and bicycles are mixed, while pedestrians may or may not joining that mix.

Focusing on walking and bicycling these same principles of sustainable safety apply:

- Identify a limited set of facility typologies by function. For cycle routes distinctions in (primary and secondary) through and access routes are made. For walking such distinctions are less common; at most prioritized zones with high pedestrian activity are identified. (Functionality & Homogeneity)
- Develop a consistent look and feel for each type that respond to their function. (Recognizable)
- Ensure design forms are accessible for all user groups and prevent severe outcomes during a collision (Forgiving).
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This approach is the first step to developing a traffic system that respects the principles of functionality and recognizability.

3 Bicycles and Pedestrian Behaviour

3.1 Safety Between Cyclists and Pedestrians

Within Sustainable Safety, the main focus lies on the safe combination of vehicular traffic with other road users, as this is where the greatest improvements in traffic safety are achievable. However, the principles are easily applied to the relationship between pedestrians and cyclists as well. Underlying this discussion is the reality that traffic conflicts between people walking and cycling are almost always negotiated safely (Beitel et al, 2017) and are significantly less likely to result in a severe outcome than conflicts between motor vehicles and vulnerable road users. Both pedestrians' and cyclists' ability to take evasive action in the event of a conflict is far greater than that of a motor vehicle and the mass and speeds involved are relatively small, which helps limit the severity of outcomes. As a result of this, issues with objective safety between cyclists and pedestrians are often so low that statistically useful data is lacking.

Subjective Safety

While objective safety is rarely a concern between cyclists and pedestrians, subjective safety should be of consideration when attempting to achieve a safe and **comfortable** traffic system. Subjective safety is usually expressed as the perceived safety of users. This perceived level of safety can often be attributed to three separate factors:

Near misses

Near misses describe events where users almost collide but manage to navigate the conflict. Many factors, including speed and proximity, dictate the relative severity of these conflicts, however many of these events are simply annoyances rather than objective safety concerns (especially between pedestrians and cyclists). More careful analysis of specific locations that have a high frequency of near misses is sometimes warranted to avoid potential future collisions.

Uncertainty

Uncertainty describes the feeling of uneasiness that is often attributed to spaces that lack structure, where the behaviour of other users may appear unclear. This element of uncertainty and uneasiness is precisely what allows these spaces to function safely. Users compensate for this feeling of uncertainty by behaving in a manner that is able to accommodate unexpected events. The basic principle underlying this factor is the theory of 'risk compensation' or 'risk homeostasis': if people perceive a situation as being 'safe', the behaviours they exhibit will incur greater risk, while if a situation is perceived as 'unsafe', people compensate by behaving more cautiously. Ultimately, the individuals' perceived 'level of safety' or acceptable risk is a constant.

Heavy traffic

Proximity to heavy traffic is found to be one of the leading causes of reduced perceived safety among all users. This applies to drivers as well as cyclists and pedestrians that may be in proximity to heavy vehicle traffic. Beyond objective safety concerns, the improved subjective safety of separating cyclists and

pedestrians from heavy traffic is important to creating an equitable traffic environment.

3.2 Cyclists self- regulate

The ubiquitous presence of pedestrian spaces and streets across Europe has led to a series of studies to evaluate whether it is safe and desirable to allow cycling in these spaces. Research across the UK (Trevelyan & Morgan, 1993) and the Netherlands (Fiets Beraad, 2005) on this topic has yielded two key results:

- In pedestrian environments, cyclists are self-regulating
- Pedestrians do not adapt their behaviour in the presence of cyclists.

This manifests in cyclists adjusting their behaviour to the density of pedestrian. Increased pedestrian densities result in slower cycling or cyclists dismounting and becoming pedestrians themselves. The conclusion of this behaviour is that cyclists will seek out alternate routes when pedestrian densities are too high regardless of if they are allowed in the space.

4 Conflict Management Strategies

Following the underlying principle that both pedestrians and cyclists should be accommodated in a safe and comfortable manner, a spectrum of strategies can be employed in order to achieve this. These strategies focus on both serving the needs of each mode as well as ensuring safety through managing conflicts. For the purpose of this study, this spectrum will be divided into three strategies:

- Mixed Environments
- Separated Facilities
- Network Segregation

Although these are identified and explained uniquely, they should be considered as a continuous spectrum with all intermediate possibilities available through design.

While there is no single solution, each strategy presents both opportunities and limitations in how they manage conflict as well as their overall impact to the traffic system, public realm and user experience. These strategies should be employed strategically and collaboratively to develop the ideal contextual approach.

4.1 Mixed Environments (Shared Space)

The first strategy is based on the self-regulating character of people operating at a human scale (on a bike or walking). Mixing people walking and cycling without visible constraints (separation of space) or regulatory boundaries (banning certain modes) results in people relying on fundamental social behaviours to negotiate space. Although this represents the most basic form of interaction in public space, it has more recently been termed 'Shared Space'.

The concept of 'Shared Space' is largely attributed to the work of traffic engineer Hans Monderman in the Netherlands during the 1990's. The essence of the concept is to reduce the structure and direction provided in traffic environments in favour of relying on social behaviour to navigate conflicts. This relies largely on the behavioural principle of risk compensation, which dictates that when people feel less safe they compensate by behaving more safely. The converse of this is also true, an increased feeling of safety, increases the level of risk one is willing to take in their behaviour. The application of this concept in a traffic environment manifests itself by reducing the presence of traditional traffic management tools such as signage, curbs, lane divisions, etc. and replacing them with more 'human' elements such as trees, street furniture and other placemaking elements

Shared Space environments can differ in many ways. In essence they are spaces in which all modes mix in the same space, but with the possibility for more clearly designated zones in which some modes may be excluded or other encouraged to operate. A common misconception of Shared Space is that there is no delineation or separation within the space; where in reality Shared Space exists on a continuum from completely

undelineated space to reasonably structured. The key element through Shared Space is that the focus is placed on the slowest and most vulnerable users, pedestrians.



Figure 4-1: Mixed traffic and pedestrian priority environment with minimal delineation

Opportunities

- Creates a social environment, which relies on user-based interactions to ensure safety. At slower speeds, users are able to navigate conflicts through eye contact.
- Shared spaces leverage the uncertainty of a less structured environment to encourage users to operate in a way that can accommodate unexpected events. This leads to slower speeds and a safer environment.
- Shared spaces have the greatest flexibility of space, which results in spatial efficiency and adaptability.
- Reductions in curb use create more easily navigable environments for those with mobility impairments.
- Best accommodates mixed mode environments where the presence of pedestrians is strong and there is limited demand for other through traffic. The presence of minor conflicts, and lowers than desired travel speeds, can lead to frustration and with that increase risk of anti-social behaviour. Therefore, for through traffic more separated designs might be more suitable.

Limitations

- The design element of shared spaces is of increased importance to engender the desired behaviour. Appropriate design features are a critical component to ensuring success.
- There is an inherent reliance on social behaviour within shared spaces. While design plays an important role to encourage the desired social behaviour, a lack of separation may increase the potential impact of potential antisocial behaviour.
- Lack of structure can be difficult to navigate for individuals with visual impairments if not properly accommodated for through alternate design features.
- High volumes of mixed through traffic may not be well accommodated. While pedestrian through traffic may be well served, other modes may suffer from a lack of designated space.

4.2 Separated Facilities

Separated facilities represent what might be seen as the default tool for conflict management. This encompasses providing separate facilities for individual modes within the same right of way. The simplest example of this is a street with a carriageway and sidewalks; pedestrians and vehicles are separated, but within the same space. From a traffic safety perspective this is an important tool as it largely limits the potential for conflict at intersections.

Opportunities

- Provides a balance between spatial efficiency and purpose-designed facilities. The combination of separated facilities in the same right of way allows for less space to be used than fully separated corridors, while providing the benefit of higher level of service for individual modes.
- Best accommodates contexts where high volumes of one mode may impede the ability for others to operate safely and effectively. This is especially the case for through traffic that prefers a higher travel speed.

Limitations

- If a mismatch exists between pedestrian volumes and the space provided, pedestrians may spill over into the cycle facilities reducing the effectiveness of the tool.
- Physical separation of facilities can present tripping/accessibility concerns.
- Coordinating access to adjacent destinations can be more difficult.
- Safe junction design may be more complex and requires careful design consideration.



Figure 4-2: Pedestrian priority environment with visually delineated cycle facility

4.3 Network segregation

The highest level of separation of modes is network segregation. This strategy employs developing completely separate networks for different modes. In its most extreme form, all modes occupy their own right of way and operate with as little interaction as possible.

Opportunities

- Limits most potential conflicts to easily discernable locations (intersections).
- Creates a more uniform user experience for each mode.
- Allows each network to best serve the unique behavioural needs of the mode it accommodates.
- Best accommodates contexts with high volumes of multiple modes.

Limitations

- Requires the greatest amount of space and resources.
- Difficult to identify unique corridors as people often have the same origins and destinations regardless of mode.
- Highly structured facilities limit the flexibility and adaptability of space.
- Likely to result in increased speed, which may result in more severe conflicts at intersections without increased controls.