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Sharing Road Safety

CHAPTER 5. OVERCOMING BARRIERS TO IMPLEMENTATION

This chapter discusses some of the challenges of safety decision making and provides an illustration on how Crash Modification Functions can support decision making to overcome some of these barriers. One of the hindrances to the widespread use and transfer of CMS is the lack of supporting documentation related to the countermeasure, the development process, and conditions under which the countermeasure was tested. The chapter provides a list of essential reporting elements for inclusion in any study presenting safety evaluation results. Finally, this chapter also discusses the underlying conditions required for sharing knowledge of effective safety policies with developing countries.

Road program and project decision making is a complex and challenging process. It usually involves such things as political considerations, public needs and acceptance, cost and the need to balance competing demands for safety, operations, economic development and other factors that all come to bear in making decisions. Safety predictions generated by CMFs are therefore obviously not the only information available nor will they by themselves be the single impetus for a final decision. This complex process presents barriers to the implementation and use of CMFs in the decision making process. Generally speaking, there are two types of barriers to consider when implementing CMFs: barriers associated with the implementation of the safety measures, and barriers associated with the application of the CMF itself.

Efficiency assessment tools can help governments choose those measures that will likely maximize the social benefits of public investment. An economic evaluation will help in identifying whether a proposed change will increase economic welfare. One of the aims of the decision making process is to ensure that resources are distributed in a way which provides the maximum level of utility (economic efficiency). Cost-benefit analysis is widely recognised as a useful tool which offers the best value for money.

Crash Modification Functions (CMFs) are fundamental to identifying the most effective road safety countermeasures and for calculating safety benefits in economic analyses of safety policies when trying to make optimal use of resources for improving road safety. It follows then that as a part of all road safety policy processes CMFs should be used as a core evaluation measure.

Despite the clear value of CMFs, this does not necessarily mean that they will immediately be implemented and endorsed by decision makers. Political decisions do not wholly conform to the principles and results of efficiency assessments. In some cases, CBA or CEA has been carried out at the early stages of the process, but the final decision is not based strictly on those results. It is also important to realize that governments may have other legitimate interests different from overall efficiency.

Another factor that can affect the implementation of CMFs is the extent of behavioral adaptation. For example, the implementation of a new speed limit will depend on the level of available enforcement and the willingness of policemen to enforce the new legislation (Ross 1981). Imposing an obligation to wear safety belts can yield either a more favorable, or a less favorable outcome depending on the willingness of drivers to follow this new regulation.

In the following sections, we describe some of these challenges that need to be met and provide ideas on how better CMFs can be useful. The key point is that any improvement in our knowledge of the effectiveness of safety measures, i.e. CMFs, will have tangible effects on the way safety decisions are made. It is crucial to use this information to improve the quality and widespread use of evidence based safety decisions.

Reducing the variance of individual CMFs and enhancing their transferability are key ways to assure the widest possible use of CMFs.

5.1. Using CMFs to overcome barriers to countermeasure implementation

While CMFs by themselves cannot overcome all barriers, they can contribute to a dialogue about the implementation of countermeasures and they can become influential in the decision making process. The most common obstacle to implementation of safety countermeasures centers on political or economic constraints, or has to do with public acceptance. The following sections illustrate how CMFs can support decision making in these constraining environments.

5.1.1. Political constraints

A CMF provides evidence about the likely impact of a certain countermeasure. For any policy to be adopted, however, it needs to be both technically and politically desirable (Rose 2001, p. 15). If the program is both technically and politically desirable, the probability of its implementation will be greater. On the other hand, a technically feasible program which is politically undesirable will be easily rejected for political reasons. Hence, the adoption of a safety initiative depends on political judgment.

The decision maker also has to have enough confidence that the policy intervention will actually reduce accidents. Safety decisions may require political will and sometimes political courage, especially when the proposed safety measure is considered socially unacceptable.

Finally, the decision maker has to know about the safety impacts of different countermeasures. This means that the relevant CMFs have to be both available and accessible (Rose 2001, p. 7).

Better knowledge of the expected impacts of different types of measures is crucial to reducing the risk of making bad decisions. Therefore, after safety measures are implemented, evaluations should be undertaken as a matter of course to improve the accuracy of CMF values, and to reduce related uncertainties. This will add to the knowledge base and reduce the risk of making wrong decisions. This could be especially important when the proposed measure is socially unpopular, thus helping the decision maker to have confidence in the expected results.

The decision making process on any safety initiative may be made without full knowledge of the impacts. This may have negative outcomes in terms of the effectiveness of the safety measure. Therefore, it is crucial to impose a process of decision making that requires the replication of CMFs.

The safety decision making process needs to be transparent. A requirement for the political process to apply CMFs in the evaluation of different safety measures and to document these correctly will provide crucial information and will greatly increase the transparency of the decision making process.

5.1.2. Economic constraints

Economic constraints can be a significant barrier to implementing safety policies. Lack of resources may limit the number of CMFs that can be developed or the available policies that can be implemented.

Implementing a public policy always requires resources and an important barrier to implementation is the absolute cost of the intervention.

This barrier is often reinforced by the uncertainty of outcomes, which can indeed be a crucial factor for adopting a policy measure, especially when the cost of that measure is high. The cost of a countermeasure also needs to be compared with available resources. The national government may have more resources and possibilities than local government and cities, while a wealthy nation may face fewer constraints than a developing country.

Some policies though, can be implemented at a very low cost. The introduction of the yellow jacket and the red triangle for emergency situations in France was a relatively cheap measure for road safety. The cost of buying these items was less than 30 euros per car while the gains associated with the use of them were directly felt by the driver.

The question of sharing costs and gains is also essential to consider. Measures with widespread benefits and concentrated costs may be more likely to face opposition whereas widespread costs and concentrated gains could potentially benefit from the support of a minority group (Olson, 1987).

Similarly, cost recovery issues need to be taken into account. Often it is a governmental agency that bears the costs of adopting certain measures. The assumption is that the government's budget is sustainable and is able to pay for adopting these measures. However, a measure can be economically beneficial but financially unsustainable. A good example is the netting-off scheme adopted by the British authorities to expand the safety camera program (Carnis, 2007).

In the opposite scenario, renouncing financial benefits can be helpful for implementing a safety policy. For instance, Queensland authorities have created a dedicated fund for revenue generated by the speed camera program. Revenue is used for communication campaigns, rehabilitation programs for road accident victims and safety related road infrastructure modifications. This requirement has been essential for the popularity of the speed camera program. Speed cameras are deployed for reducing road fatalities, and not for raising revenue, but the program is possible because it is financially sustainable.

Because economic constraints can be difficult to overcome, it is essential to ensure optimal outcomes. A key policy challenge is to create decision making structures that encourage the selection of the most cost-effective safety policies, those that deliver optimal safety outcomes for the lowest cost. Governments need to get the greatest return possible, especially in times of tight budgets.

Therefore, road safety policies should undergo performance and efficiency evaluations, which cannot be undertaken without CMFs. The better our knowledge is on the effectiveness of different road safety measures, the smaller the risk of making wrong (or bad) decisions. More reliable and transferrable CMFs reduce the risk of wasting scarce resources for non-effective policies. Evaluations of the effectiveness of safety measures should be undertaken as a matter of course to improve the accuracy of CMF values and reduce related uncertainties.

There are also gains to be made in terms of saving money in producing CMFs. If results can be made more easily transferrable, this reduces the need for individual countries to carry out expensive research on the impacts of different countermeasures. The development of reliable CMFs is time consuming and costly; the development of one CMF alone can cost up to $200,000.

5.1.3. Public acceptance

Public acceptance can be a major issue in the successful implementation of safety measures. Any information that can help the community to understand that the proposed measure will lead to improved road safety can help in fostering acceptance. Communicating the benefits of safety measures through different media is therefore important.

A measure can yield an expected and direct effect, but can also generate an indirect and undesirable effect. Implementing a speed camera program can be helpful in reducing speed and the number of road accidents. However, if it leads to a reduction of police enforcement, the picture is less clear concerning the net effects (Carnis 2010). A safety measure can also be diluted by behavioral adaptation from drivers or by poor implementation. Adopting a speed camera program does not imply they will be installed at the correct place or that drivers will obey blindly the new regulation.

Evidence based on past experience needs to be communicated. CMFs are a way to measure the effectiveness of past experience. There is also a clear need to carry out follow-up studies to validate results from previous CMFs. These studies will help to calibrate results when applying safety measures in different countries or locations. More importantly, however, they will help to communicate results to the public later on, while simultaneously adding to the knowledge base.

Researchers and policy makers need to have an information or dissemination plan that provides the public with objective information on the impacts of a countermeasure. This type of communication plan is important also for the public to understand what the actual safety problem is, and what the benefits (and related costs) of countermeasures are. There is a need to “celebrate successes and remember failures”.

Finally, cost-benefit assessment provides a framework for assessing societal pros and cons of policy interventions. CMFs, as a part of economic assessment, can help in presenting a fair and balanced view of outcomes that can be used to balance safety issues with other agendas, such as CO2 emissions or labour issues. Informed decision making helps in increasing public acceptance.

5.2. Overcoming barriers to the implementation of CMFs

As the adoption of a new safety countermeasure is complicated for a number of reasons, the decision to use CMFs potentially challenges professionals and organizations that are not currently using them. From the fundamentals of simply knowing what a CMF is to the more difficult challenge of understanding its relevance in a particular context, the challenges described in the following sections illustrate the need for more professional development in the understanding and use of CMFs for more rapid advancement of this science.

5.2.1. Contextual challenges

The adoption of a 55 mph speed limit in the United States was an adequate measure for many states and large urban areas. However, it may be less adequate for some rural states with low population density and little law enforcement. Similarly, is it meaningful to generalize day-light running regulations for all EU countries? It would be adequate for Nordic countries with a low level of luminosity and long winters but could be less useful for southern European countries.

Different levels of government can also lead to conflicting objectives. It may not be possible to implement a safety policy because some aspects are not legally recognized at a higher political and governmental level. For example, a city may not be in a position to implement a specific radar device because federal law forbids the use of such a device.

Another example is the impossibility of prosecuting foreign drivers for speeding when enforcement is carried out by automatic devices. For example, the French automated speed enforcement system cannot catch a Spanish driver.

Finally, some ideological constraints can be obstacles to transferring and implementing an appropriate policy measure (and use of CMF). This could be interpreted as a failure in translating general knowledge to the particular situation. Some measures might be either adopted or rejected because they were implemented in countries with which there are strong political agreements or disagreements. For instance, Anglo-Saxon countries are more inclined to exchange and to share similar solutions because of cultural familiarity (Rose 2001, p. 17).

Safety decisions are made within the constraints of institutional barriers. The decision to transfer an intervention from other countries should be based on sound knowledge, and has to take into account contextual challenges. Importing a CMF assumes that the new social and legal context will be similar enough to that of the original country to ensure successful implementation of the intervention.

In order to overcome these types of challenges, it is crucial that research on the effectiveness of the countermeasure (and related CMFs) document in detail the context in which it was developed. When using CMFs developed elsewhere, users can then take into account the context in which they were originally developed. As part of the adaptation process, it is also essential that the rationale for the modified CMF be documented and applied consistently. Chapter 5.3. recommends items essential for inclusion in any study presenting safety evaluation results.

Qualitative knowledge and investigations emphasising cultural and other institutional differences can be useful in transferring safety measures (and CMFs) from one context to another. For instance, roundabouts could be appropriate for reducing crashes at intersections in urban areas. However, they might not be the best solution for intersection crashes in rural areas. A potentially better solution might be a modified intersection that uses some aspects of roundabout technology. This kind of solution involves the adaptation of general knowledge to a local problem. A wide knowledge base that includes both technical and non-technical methods to address traffic safety issues would be useful for designing appropriate public policies. However, it is important to highlight that assumptions still need to be documented and applied consistently without changing them constantly according to subjective needs.

5.2.2. Knowledge

Transfer and implementation processes assume that the decision maker clearly understands the safety problem under consideration. Are the traffic fatalities explained by excessive speed? Or is drunk driving more of a problem? The decision maker needs to have a certain amount of information available to conceptualize the problem and potential solutions. Therefore, it is important to ensure that an adequate crash database is available in the first place to accurately identify the true nature of the safety problem.

Capacity building is an important element in the transfer of knowledge from one context to another. If users don't understand CMFs or how they are used, this will prevent the implementation of effective safety programs and measures. Traffic safety knowledge includes information about treatments and their effects, countermeasure development and related CMFs, but also includes statistical details such as sample size, etc. Through capacity building and education, it is possible to move from subjective towards objective knowledge.

Countries should make efforts to ensure that practitioners become familiar with CMFs and their use. This will require knowledge transfer and capacity building through international efforts, possibly in the form of workshops, the preparation of guides and best practice manuals, and twinning projects.

There should also be minimum methodological standards for the development of CMFs. Previous chapters have provided guidance on how CMFs should be constructed and evaluated. As noted earlier, after safety measures are implemented, evaluations should be undertaken as a matter of course. The results of these evaluations, along with an indicator of how reliable the results are, should be stored in a transnational database.

In order to ensure the quality and homogeneity of safety assessments carried out at various levels, including national and regional, some possible actions are:

- The development of good practices guidelines and recommendations. The new US Highway Safety Manual, the European thematic network ROSEBUD and the European Project SUPREME 1 are prominent examples of such initiatives.
- The creation and maintenance of transnational databases, with sound estimates of the effectiveness of safety measures. These comprehensive databases would ensure that practitioners do not overlook any significant measure when screening for available options.
- The establishment of a system for quality control, based on independent and impartial reviews of efficiency assessments.

Finally, the reinforcement of international co-operation and communication between policy-makers and the scientific community about effective safety measures is an important step to overcoming knowledge related barriers for implementing safety policies. The transfer of CMFs and knowledge about current practices will enable authorities to make decisions even if resources are unavailable for them to make their own estimates.

5.3. Essential reporting elements for safety studies

The question of transferability concerns the circumstances under which different safety measures are implemented. Ideally, two identical measures, implemented in identical circumstances, should have the same impact on the frequencies of accidents and casualties. Conversely, discrepancies in circumstances are expected to induce discrepancies in effectiveness.

It is essential that researchers disseminating the results of an effectiveness assessment provide a description of the circumstances as accurately and completely as possible. This will allow researchers and practitioners from other regions and countries to evaluate the possibility of successfully transferring the measure. Whenever possible, information about circumstances should also be quantitative; only then can crash modification functions be developed.

There is no unique set of circumstances that is relevant to every research question. For example, while the initial speed of traffic flow can (and most probably will) influence the effectiveness of speed cameras, it is hardly relevant to the assessment of the impact of technical inspections.

Along with information on circumstances, every study should provide the standard error of the estimate of effectiveness, as well as some basic information about methods: study design, samples, data sources, and biases.

International transferability of the results of road safety evaluation studies is only possible when studies are available from many countries, over a long period, and when all these studies are of at least adequate and similar methodological quality. Many different designs are used in road safety evaluation studies – it may therefore be too restrictive to require that all studies be identical down to the finest detail. It is, however, reasonable to require that studies have uniformly controlled for at least the most important potentially confounding factors.

As documented previously in this report, one of the hindrances to the transfer of CMFs is the lack of supporting information related to the countermeasure, the development process, and conditions under which the countermeasure was tested. The group therefore recommends that all studies related to CMFs should provide as much documentation as possible in order to facilitate the exchange, transfer and application of the CMF to the fullest extent possible. Box 5.1. presents those items considered essential for inclusion in any study presenting safety evaluation results.

While the items presented in Box 5.1 are essential, they are not all inclusive. Box 5.2. provides a full list of information that would be desirable to have documented in CMF reports.

Box 5.1. Essential reporting elements

Countermeasure description

1. Detailed description
2. Baseline & future
3. Range of application (e.g. specific and general determinants (use of speed cameras))

Safety

1. Crash target group; type and severity (if infrastructure-related countermeasure)
2. Target risk factors (e.g. speeding, red light running, drunk driving, dangerous curves etc.)

Environment

1. Speed environment (speed limit)
2. Urban /rural (outer urban, semi-rural, suburban)
3. Geometric elements (e.g. divided/undivided, alignment, shoulders - hard/sealed)
4. Volume by key road user type

Box 5.2. Desirable reporting elements

Measure

Provide a description of the road safety measure with as much detail as possible, including information about the population of treated entities:

1. Nature and type of treated entities:
   - Road user: drivers, occupants, pedestrians, etc.
   - Vehicles: motorcycles, passenger cars, trucks, etc.
   - Road entities: segments, intersections, etc.
2. Traits of treated entities:
   - Road user: age, gender, etc.
   - Vehicles: age, mass, load capacity, etc.
   - Road entities: type of road, layout, accesses, configuration of intersection, speed limit, etc.
   - Criteria for selection of treated entities (e.g. frequency of accidents/casualties?)
   - Environmental conditions

Outcomes

Define outcome variables: accident, fatality, seriously injured. Report frequencies before and after.

Exposure

Provide information about exposure (average daily traffic or kilometres driven) in the population of treated entities, both before and after the implementation of the measure.

Other information about traffic conditions, if relevant

Enforcement level, average speeds, etc.

Control/comparison group

Clearly describe control/comparison group, if applicable.

Methods

Clearly describe methods, including:

- Samples
- Periods
- Study design (experimental, before-after, cross-section, case-control, multivariate models, time series)
- Treatment of potential biases (diffusion of treatment to control/comparison group, regression to the mean, long-term trends, changes in traffic volume, co-incident events, accident migration, etc.)
- Definition of independent variables
- Sources of information, and their accuracy (e.g. underreporting, errors of measurement)

Results

Estimates and standard errors

Other results: analysis of subgroups, sensitivity analysis

5.4. Sharing CMFs with Lesser Developed Countries

A CMF, although predictable in one or more developed countries, may or may not be fully realized in lesser developed countries. There are many contextual elements that can affect the eventual actual crash reduction that could occur if conditions are not the same as in the country or countries where the

CMF was developed. This is perhaps a more critical consideration when CMFs are applied in a developing country. For example, a paved or hard shoulder in most developed countries can predictably reduce crashes by a certain amount. However, a paved or hard shoulder in a lesser developed country might encourage improper use of the road environment – e.g. the erection of stalls for selling items to travelers – that could decrease the overall safety of the roadway environment.

Conversely, it is also possible that a CMF that has proven reliable in developed countries could have higher benefits when applied in a developing country. Returning to the paved or hard shoulder example, if there is highly mixed motorized and non-motorized traffic on a roadway, the paved or hard shoulder might default to a lane that accommodates the non-motorized traffic. Such a separation could potentially have greater safety benefits than if the shoulder is only used for traditional or primary purposes.

The simple examples provided above highlight the need to identify as much as possible any unintended consequences that could occur when a countermeasure is applied. Therefore, as one considers the application of a CMF developed in a more industrialized country to a less developed country, certain underlying conditions should be considered when evaluating the success of that application in the new environment. If the underlying conditions will prevent the full benefits of a countermeasure to be realized as predicted by a CMF, then consideration should be given to how the underlying condition can be managed or mitigated. If it cannot be managed or mitigated, the proposed countermeasure may not be the best choice for the situation.

The underlying conditions described below are typical conditions found in the developed world that can have an effect on the results of the implementation of a CMF if these conditions are not found in a lesser developed country. Efforts should be made to understand these factors in any country where a CMF is to be applied with the intent of considering if the environment or context is substantially different from that in which the CMF was developed. If it is substantially different, then one must make an effort to estimate the impact on the safety outcome of the application of the CMF in the new context.

i. An effective government

A government that produces effective legislation and provides appropriate regulation can have an influence on the successful implementation of a CMF. Without an effective government in place, not only will the decisions about which countermeasures should be applied be more complicated, but underlying legislation that establishes appropriate behaviors on the roadway may not exist. Likewise, regulatory enforcement may not be possible, thus creating a situation in which safety benefits from certain countermeasures may not be realized as other safety problems caused by lack of regulatory control are overwhelming. The lack of an effective government can also lead to the lack of sufficient financial resources that may limit the achievement of results predicted by a CMF. For example, the quality of the implementation of a countermeasure, if not constructed or installed properly, could prevent the full realization of safety results.

Finally, having accurate and reliable crash and traffic information - including communication and information systems - at the right place and time facilitates the application of CMFs. These will likely be non-existent without an effective government in place.

ii. Governance

The existence of both laws and the enforcement of those laws is perhaps the most significant issue for obtaining predicted safety results. In the shoulder example above, there should and likely will be a law that does not allow stalls or vendors on shoulders.

If, however, that law is not enforced, then the lack of good governance will prevent the full achievement of safety results. Similarly, the lack of the establishment of truck size and weight in many countries does create a scenario in which the outcomes predicted by CMFs may not be realized.

iii. A homogeneous, motorized population

For the most part, the vehicle fleets in developed countries are fully motorized and reasonably homogeneous in their design, mix and operational characteristics. While this may be true in some developing countries, it is also likely that there is a far wider spread of vehicle types, both motorized and unmotorized, in many developing countries. This creates an entirely different environment from that in which the CMF was developed. As a result, the impact of a particular countermeasure as predicted by a CMF may not be realized.

KEY MESSAGES

- As a part of all road safety policy processes, CMFs should be used as a core evaluation measure and they should be documented, thus ensuring transparency.
- To ensure optimal outcomes, road safety policies should undergo performance and efficiency evaluations, which cannot be undertaken without CMFs.
- After safety measures are implemented, evaluations should be undertaken as a matter of course to improve the accuracy of CMF values and reduce related uncertainties.
- The results of these evaluations, along with an indicator of how reliable the results are, should be stored in a transnational database.
- As part of the evaluation process it is necessary to document key evaluation elements such as context (see Chapter 5.3.).
- There should be minimum methodological standards for the development of CMFs.
- Researchers and policy makers need to have an information or dissemination plan that provides the public with objective information on the impacts of a countermeasure. There is a need to "celebrate successes and remember failures".
- Countries should make efforts to ensure that practitioners become familiar with CMFs and their use. This will require knowledge transfer / capacity building through international efforts (e.g. workshops, guides, best practice manuals, and twinning projects).
- When using CMFs developed elsewhere, users need to take the context into account.
- When transferring CMFs, as part of the adaptation process it is essential that the rationale for the modified CMF be documented and applied consistently.
- It is important to reinforce international co-operation and communication between policy-makers and the scientific community about effective safety measures.

NOTE

1. Highway Safety Manual (AASHTO, 2010; http://www.highwaysafetymanual.org).

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