ABSTRACT

A wide variety of policy measures and interventions can be applied in order to promote efficient, accessible and sustainable transport systems. However it is widely recognized that transport systems are complex and their performance depends on multiple factors. It is therefore a significant challenge to ensure that policies actually lead towards their intended objectives, and to avoid unanticipated negative side-effects within and beyond the transport sector. One way to approach this challenge is to adopt integrated policy packages where measures supplement each other and compensate for expected negative effects of individual measures. A key element in a systematic approach for policy packaging must be to enable the identification in advance of non-intentional effects of individual or joint policy measures. This paper develops a typology of non-intentional effects of transport policy measures as part of a methodology for policy packaging in the OPTIC research project. The paper first establishes the need to address systematically unintended effects and then proceeds to unfold the dimensions of the typology with concrete examples along the way. Ways to use the typology is discussed in the final section of the paper.

1. BACKGROUND : TRANSPORT POLICY OBJECTIVES AND EFFECTS

A wide variety of policy efforts and interventions are undertaken in order to promote efficient, accessible and environmentally sustainable transport systems. Meanwhile, it is widely recognised that transport systems are highly complex. They connect to virtually all areas of society and their performance is dependent on multiple factors. Moreover there is an interplay between policy decisions taken at different levels, at different times, and for different purposes. The policy decisions may have indirect as well as direct effects (Burgess & Tavasszy 2004).
The most comprehensive representation of European Transport Policy (ETP) presently in existence is arguably the one given in the White paper: ‘European transport policy for 2010: Time to decide’ (CEC, 2001) and its Mid-term review (CEC, 2006). At present there is an ongoing process leading towards a new White paper on transport. Although some transport objectives have been achieved, the environment is an area where further improvements are necessary, in particular with regard to emissions of greenhouse gases (CEC, 2009). The present situation thus continues a history of observations about partial failures in transport policy and governance in Europe (Groenleer et al 2008; Schmidt & Giorgi 2001; Tengström, 1999; OECD 1992).

This means that the design and implementation of appropriate transport policy measures involves several challenges. One challenge is to ensure that individual policies actually lead towards their intended objectives. This can be difficult to ensure given the limited knowledge of the total system and the presence of countering effects from other measures and repercussions during implementation. Another challenge is to avoid unanticipated side-effects on other policy objectives or other policy domains than the one in focus. Today most transport policy interventions tend to focus on single measures for single purposes, and there is limited guidance available on how to address counter – and non-intentional effects through careful combination of various policy measures.

There is thus a need for methodological advancement in order to underpin a comprehensive and integrated understanding of transport policy design and packaging. The paper is a preliminary outcome of the EU FP7 project OPTIC (Optimal Policies for Transport In Combination), which has the aims to improve our collective ability to analyze the likely effects of transport policies and to develop methodologies for systematic policy packaging.

To set the context for considering unintended effects of transport measures it is useful to consider existing experience with effects of transport policy measures and interventions, especially evidence regarding non-intentional effects. A literature based review of such experience is briefly summarized and examples given in Section 2.

The typology on non-intentional effects is developed in section 3 following a logical progression along two dimensions. The first is to build on a notion of policy maker’s intentions. Effects of interventions can be conducive to such intentions or not in various ways. Secondly it is critical to address the type of awareness or knowledge one can have or not about such effects. This knowledge can be more or less advanced, e.g. fully quantifiable with models, only conceptual, or non-existent, as the effects are unknown or even beyond imagination. In contrast to standard ways to define transport policy effects the typology for non-intentional effects is derived from a combination of these dimensions rather than by seeking to classify specific impacts into categories such as economic, environmental, short term, long term, internal, external etc. The advantage of this approach is that it is applicable at a general methodological level, independent of which ever concrete effects are on the radar screen of current policy making. The present typology is a first approach that may be revised. Suggestions for improvement are invited.
After the typology, a brief discussion is offered in Section 4 on how it may be useful for policy design and packaging. However, this theme is addressed fully in another paper on the Policy Packaging Framework developed in OPTIC presented at ETC, and therefore gets limited treatment here.

2. TRANSPORT POLICY MEASURES AND THEIR EFFECTS

Failure to fulfil objectives can have many causes; examples include inadequacy of the selected policy measures, unintended side-effects of those or other measures, limits in the implementation process, or outside factors. In this section we will look at some actually adopted transport policy measures and discuss to what extent adverse non-intentional effects have been observed as a possible cause for limited fulfilment of objectives.

Figure 1 presents a general system perspective of the interactions of the transport systems with other sectors of the economy. It notes relations between overall policy objectives and transport specific ones, and trace their impacts through the transport system. The main point of the figure is that transport generates a wide range of effects through a variety of complex mechanisms.

![Figure 1: A system perspective on the interrelations between overall policy objectives, transport policy objectives and measures, direct transport related effects, and final impacts.](image-url)
A total of 79 examples of different types of adopted measures reported in literature from around Europe and across a broad range of transport sectors have been gathered and described (for full details see TSU et al. 2010). The analysis includes aspects such as the objectives of the measures, their successfulness, and, which is of special interest here, the reported occurrence of unintended effect, of policies, and/or introduction of complementary measures to compensate for such possible weaknesses.

It is remarkable that what we here broadly call unintended effects was in fact reported for the majority of the examples in the inventory. One example of a policy with such effects is CO₂-differentiation of vehicle taxes in Norway. While it reportedly contributed to reduce CO₂ emissions from the new car fleet, a negative unintended effect has been higher share of diesel cars and thus higher emissions of PM-10 particles in urban areas. Another example is the construction of a new 50 km road connection through a remote island area. The link has contributed to reduce travel times significantly, but also appears to foster regional disintegration due to a division of established public transport and freight routes. In the Czech Republic a motorway toll system for lorries has reportedly led lorries to start use low class roads, with potential negative environmental and safety effects.

However, unintended effects can be both positive and negative. An example of a positive effect is the introduction of digital tachographs, which in Germany is reported to have helped trucking companies improve their fleet management abilities. In several cases it is unclear if possible unintended effects actually have occurred or not. For example an information service for vessels in the Dover Strait may have improved safety, but may also encourage higher vessel speeds.

We summarize the following key observations from the review:

- Some form of unintended effects seem to occur in the majority of examples, predominantly on the negative side, although positive effects and examples with mixed consequences are also reported;
- Evidence of unintended effects is sometimes scarce or even non-existent.
- However, in the inventory of measures no clear relationships were found between the type of measure introduced and the nature of positive or negative unintended effects

There is thus a clear need to seek a better understanding of the unintended effects as a first step of providing proper remedies against them.

3. BUILDING A TYPOLOGY OF UNINTENDED EFFECTS

As already indicated it is not surprising that political interventions as well as innovations are leading to many types of ‘unintended’, ‘unwanted’ ‘perverse’, (Albalate and Bel, 2008), or even ‘self-defeating’ (Sunstein, 1997) effects, especially in complex socio-technological systems such as transport (Grunwald 2008).
In this chapter we will build a typology drawing from various fields of policy related research while we illustrate and populate the typology with examples from the transport literature. We will concentrate on, as we define them, significant non-intentional effects which may or do arise directly or indirectly through policy interventions in the transport sector

By ‘policy’ we here mean ‘public policy’ defined as a decision or a set of interrelated decisions by political actors concerning goals and means of achieving them in a specified situation (Jenkins 1978). Policy can be understood in terms of both ideas and processes (Palm 2001, Hill 1997). A policy might thus refer to a specific intervention, or program of interventions, but also formation of the intervention(s) and the process of practical implementation.

Next, the notion of non-intentional effects is obviously based on an idea of ‘intentions’. In standard vocabulary something is ‘intended’ or ‘intentional’ if it is “purposed to be done or accomplished”; and ergo something is ‘unintended’ or ‘unintentional’ if it is “...not done with, [or] not arising from, intention.” (Oxford English Dictionary 1989). Here we consider as ‘policy intentions’ the political decision makers’ explicit intentions with respect to the policies they design and adopt. Main indications of these intentions would be explicit aims or goals stated for a policy intervention.

Effects are thus discussed here in terms of intention and causation, whereby a political intervention ‘I’ has primary intended effect(s) but potentially multiple consequences ‘A’, ‘B’, ‘C’ etc., some of which are likely to be unintended, and/or unanticipated.

3.1 Primary and secondary effects

The effects that relate to specific, explicit goals (intentions) we call primary effects. In the case of, say, enforcement of speed limit measures near schools to protect school children from accidents, the primary effects of this policy concern (positive or negative) on children’s traffic safety in those areas.

Effects may also refer to other objectives, which nevertheless retain importance to pertinent actors, which we call secondary effects. This could be impacts of the traffic safety measures on other than the target group, say safety of adult road users in the area, or on other goals, say objectives to keep enforcement expenses low, or objectives to save energy in traffic.

Considering the systemic character of transport secondary effects may arise that are either ‘transmodal’ (i.e. having an operative influence on one or more other transport modes than the targeted one) or ‘transsectoral’ (i.e. having an operative influence on one or more other sectors of the economy).

3.2 ‘Positive’ and ‘negative’ effects – the normative aspect

Some effects may be perceived as ‘positive’, ‘beneficial’; others as ‘negative’, or ‘adverse’ by some or all policy actors. Different policy actors may obviously have different perceptions of or interests in the value of the same effects.
Here it is important for the consistency of the typology to maintain the connection to the policy intentions rather than to 'subjective' interests or objective results. This means that we prefer to talk here about 'intentional' versus 'non-intentional' effects rather than attractive versus adverse ones.

Next, non-intentional effects on primary objectives, altering the net 'usefulness' of the intervention can be either expedient (or what we can call *serendipitous*, obtaining a desirable outcome in an accidental way), or inexpedient (which we term-counter-intentional). Adams et al (2003, p. 66) exemplify the former schematically as follows: “Captain issues incorrect orders; Crew implements orders incorrectly; Unexpected change in winds currents; Desired course may be achieved by pure luck”. In the latter case an unrecognised mechanism associated with the intervention undermines the intended effect. A simulated example is when provision of low quality information about congested roads to drivers read them to shift route *en masse*, which then in fact worsens the delays (Emmerink et al 1995).

### 3.3 Some examples in the transport literature

A classic example of a primary counter intentional effect in the area of policies designed to curb the extent of private car travel in European cities was discussed by Goodwin (1998), highlighting the complex adaptive problems that result from road building schemes. Using the example of a bypass, he contends that although the intended effect of the additional road space is to alleviate traffic and congestion along the original route and increase speed on the new route, a counter intentional effect of its construction may be an overall increase rise in net travel—the now widely-recognised phenomenon of induced demand (Noland, 2001).

A striking example of a secondary effect is provided by Robinson (1996) in her detailed analysis of the introduction of mandatory bicycle helmet legislation in Australia. The legislation was introduced explicitly to reduce the proportion of cyclists suffering head injuries and a superficial analysis of the available data appeared to indicate that the legislation had achieved its intended effect. In the state of Victoria, for example, the percentage of cyclists wearing helmets increased from 31% to 75% in the first year of the legislation. Similar trends were evident elsewhere in the country, with the percentage of child cyclists in New South Wales wearing helmets increasing from 31% to 76% (reaching 85% for adults). Moreover, the proportion of head injuries in hospitalised cyclists fell by 13%. However, longitudinal data also revealed that the mandatory legislation had triggered a reduction in the number of child cyclists up to 15 times greater than the increase in the number of children wearing helmets—suggesting that a major unintended effect of the legislation had been to discourage cycling.

Secondary effects may also occur with delay, which can make them even more difficult to detect. In summarising work of Hass-Klau (1993) and colleagues on pedestrianisation interventions in European cities Goodwin (1998) notes that the intended effect of the interventions was to improve the quality of the urban environment, specifically ‘walkability’ in certain districts (see Southworth, 2005). While this intended effect was largely realised,
however, the intervention also appeared to have the unintended effect of discouraging retail trade by making it more difficult for individuals to access shops by other means, particularly by private car. As it turns out, however, these are likely to be short-term effects only and primarily arise due to the disruption of shopping patterns during the intervention’s implementation phase. It appeared that the pedestrian footfall in newly pedestrianised areas was between 20% and 40% greater prior to the schemes’ introduction, thereby leading to a serendipitous increase in the net volume of retail trade (Hass-Klaau, 1993).

3.4 Knowledge and program theories

Effects – intended or not - may be known or not known, anticipated or not anticipated; receiving attention or not; they may be neglected, misunderstood or suppressed. This adds another dimension to the analysis of policy effects. These phenomena refer to whether some possible effects are perceived or not in a given situation, rather than to their nature with regard to the intentions. This knowledge may provide steps towards understanding why counter-intentional effects may arise, and therefore possibly how to mitigate them.

<table>
<thead>
<tr>
<th>Consequence dimension</th>
<th>A. Intentional</th>
<th>B. Non intentional</th>
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<tbody>
<tr>
<td>W. ‘Known’</td>
<td>The consequences that decision makers intended with the intervention</td>
<td>Counter-intentional effects that were anticipated at the time of decision</td>
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<tr>
<td></td>
<td>Average fuel consumption of new vehicles is reduced; less fuel is consumed</td>
<td>Cars are driven longer and consume more fuel due to lower fuel cost/km (rebound effect); models may predict the effect</td>
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<td></td>
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</tr>
<tr>
<td>X. ‘Unknown’</td>
<td>Advantageous effects that are not known; serendipitous</td>
<td>Counter-intentional effects not known at the time of decision</td>
</tr>
<tr>
<td></td>
<td>New cars inspire some people to ‘green driving’ lifestyles, saving additional energy</td>
<td>Car manufacturers economically challenged by the standard abandon plans to develop even more energy efficient cars</td>
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Table 1. Consequences versus Knowledge. A speculative case on the effects of introducing a fuel efficiency standard is used to exemplify each type.
We will first make a basic distinction between situations where effects are ‘known’ (labelled ‘W’) versus ‘not known’ (X). Then we map these onto the previous categories of intentional (here labelled ‘A’) and non-intentional (‘B’) effects, which are divided into two, ‘B1’ counter-intentional effects relating to the primary objectives, and ‘B2’, to secondary effects.

In Table 1 the emerging six categories are defined and illustrated with a simple example of a hypothetical measure to reduce the fuel consumption of transport by introducing a fuel efficiency standard.

However, the question of knowledge of policy effects is clearly not adequately dealt with as an ‘either- or’ situation. Varying ‘degrees’ of knowledge may exist. A useful contribution to this question is popularly ascribed to Frank Knight (Runde, 1998) with the distinction between, ‘risk’ where knowledge and parameters are available to assess the likelihood of some outcome; while ‘uncertainty’ refers to a more genuine lack of understanding of causal relations. Another distinction has been proposed by Merton (1936) who refers to at least four different reasons for the occurrence of unanticipated effects arising from purposive action including ‘ignorance’, ‘error’, ‘bias’ and ‘feedback effects’. This draws attention to the important aspect of how available knowledge is actually appreciated. Scholars such as Howlett (2000) and Mickwitz (2003) emphasize high complexity and variability in context as key conditions for modern policy making; such factors may explain why existing knowledge fails to predict unintended effects.

Taking inspiration from these and other characteristics we propose to divide situations with regard to the knowledge into four broad categories, (W, and X1, X2, X3) centring on the role of causal models linking interventions to policy effects. Such models are also referred to as ‘program theories’ in the language of evaluation research (Johnson et al., 2009). Two broad characteristics influence the adequacy of these causal models, namely whether they are conceptually accurate and exhaustive, and if so, if they are specified and calibrated correctly to the context. The four situations are:

- (W) Situations where recognised causal models linking intervention to effects exist and is specified to correctly predict effects in context
- (X1) Situations where recognised conceptual models are applied, but the actual application of them to context fail to consider full effects
- (X2) Situations where causal assumptions are made in policy, which however fail to take into account significant recognised causal models, or evidence
- (X3) Situations where there is no agreement over causal models, and no models to predict cause and effect are feasible

The full typology is built by combining these knowledge situations with the types of effects with regard to intentions introduced earlier. In total 12 combinations are possible. In the following section we discuss selected types that we found to be particularly relevant to consider in a context of policy assessment and package design. This means we omit correctly anticipated intentional effects and go directly to ones in different kinds of error. In the discussion we apply further dimensions of failure to predict unintended effects, namely strength of the effects, and system boundary for the effects. Each
category have been given characteristic name labels for intuitive recognition. Examples are given to illustrate each type; the examples are for clarification purpose only, and should not be seen as statements about of actual effects of measures.

3.5 Key types of non-intentional effects

‘Overdone’. Policy-makers have a relatively correct causal model of the policy situation (i.e. it includes the relevant major variables), but nevertheless their ‘weighting’ of the various elements is inaccurate, thus the actual outcome *inflates* notably from the predicted outcome in terms of magnitude or timing. For example, if a new fuel based vehicle tax aiming to reduce fuel demand leads to a series of stronger adjustments in purchasing behaviour than anticipated. This effect may be welcome, but could also suggest unnecessary restrictions are being imposed.

‘Spill over’. Policy-makers here also have a relatively correct causal model of the policy situation, but they omit a part of the whole causal system from their considerations, for example because some effected area does not fall under their jurisdiction. An example could be traffic calming efforts leading to a reduction in speeds on a road network, near a municipal border where some of the speed reduction takes place in the neighbouring municipality, and is therefore not counted. The policy may not be adopted in the first place because it has too small perceived effects compared to cost.

‘Off the Mark’. Also here, policy-makers have a relatively correct causal model of the policy situation (i.e. it includes the relevant major variables), but again their weighting of the various elements is partially inaccurate, so that the measure fails to produce the expected results in terms of magnitude or when it occurs. In this case a counter effect, or ‘drag’ is underestimated or overlooked. For example, a policy measure to reduce the use of mobile phones while driving is introduced, but the policy underestimates the complications involved in detecting violations, and thus overestimates the long term effects of compliance (Caird, 2008; Dragutinovic and Twisk, 2005).

‘Not-In-My-System’. Policy-makers have a relatively correct causal model of the policy situation that includes the relevant major variables, but they omit a part of the whole causal system from their considerations, For example because falls outside jurisdiction or policy domain. In this case it creates problems elsewhere. In the example of traffic calming the efforts reduction in speeds could also lead to some detouring cars using higher speeds through a neighbouring municipality, which are not considered. In this category the unintended effects are still of the same type (hence, primary) as the ones addressed by the policy intention, but parts of the interactions are left out.

‘Blind spot’. Here policy-makers assume an inaccurate causal model of the policy situation (i.e. ignores relevant major variables or interactions), and thus the predicted outcome of the intended effect differ significantly from the actual outcome leading to counter-intentional effects. The knowledge misspecification could be due to ignorance, ‘optimism bias’, time pressure,
regulatory capture, contextual details or other causes. In each of these cases the possible remedy could differ. An example could be the European policy makers failing to adopt low noise car tyre policies as part of a plan to reach road noise objectives because of the trade off between positive noise effect and traffic safety of tires. According to Sandberg the European Council and Parliament indeed assumed such a position in 2001, even if recent available research had confirmed this conflict to be a myth (Sandberg 2001). In a worst case it may be ‘blind spot with a vengeance’, if the counter effect is so strong that the intervention moves the system in the opposite direction to the one intended by the policy. This is expressed by Sunstein (1997, p 116) as a ‘regulatory paradox’, like if biofuels introduced to lower climate impacts of transport, actually make them worse (Devereaux and Lee, 2009).

‘Secondary blind spot’ Here the inadequate causal assumptions extend into secondary effects, which may in principle be known before, but are in this case not discovered or considered in the analysis of the policy makers. The elements ignored in this instance can potentially encompass a very wide spectrum of secondary effects, and is therefore particularly challenging to address. A vehicle scrappage scheme introduced in UK in May 2009 can illustrate the point. The scrappage scheme had three main intentions, to support domestic car industry, to improve road safety, and to improve the environment. According to the auto industry the program is very successful in terms of boosting vehicle sales and speeding up the introduction of more fuel efficient vehicles (SMMT, 2010). However, there is limited evidence about the extent to which the effects are attributable to the scheme and about wider system effects. The ‘program theory’ behind the scheme did for example not consider (possibly counter intentional) environmental effects connected to shipping and disposing of scrapped or production of new vehicles. On the other hand, it did also not consider additional economic industry benefits from spare parts. The causal chain can be extended by speculation into further possible effects areas such as lobbying for a continued scheme leading to new reactions among consumers, policy makers etc.

‘Black Swans’ An effect can occur that was not known before, never occurred in that policy context or have only existed as speculation. Sometimes such events have effects that far outweigh normal occurrences Taleb (2007) labels these phenomena ‘Black swans’. In this case policy-makers’ causal models could not possibly incorporate certain variables. Effects can materialise forcefully, as for example ineffective airport safety controls indirectly allowing the unprecedented disaster to occur in New York and Washington on 11 September 2001. One may find that the outcome was beyond comprehension, or that it was due to a series of blind spots (The 9/11 Commission Report 2004). Black Swans are by nature hard to predict, but a coping strategy may be to build robustness into vulnerable systems.
4. DISCUSSION AND FUTURE WORK

This paper has sought to deliver parts of a building block to manage the complex causal processes involved in transport policy-making at the European and national levels.

The exercise first demonstrated that non-intentional effects and barriers to successful implementation occur frequently in such interventions, regardless of measures’ specific objectives, types and geographical scales. Systematic ways to deal with such phenomena seem to be missing.

Recognising the complex and heterogeneous nature of the non-intentional effects, we developed a systematic typology of such effects. A review of types of non intentional policy effects has been drawn up through the two key dimensions of a typology namely, how the effects stand in regard to the explicit intentions of the policy makers adopting them, (e.g. conducive, or countering to them), and how well developed the knowledge of the effects are (e.g. fully quantifiable with models, only conceptual, or non-existent)

As a result, the typology was concerned with establishing conceptual clarity, providing a useful categorisation of types of non-intentional policy effects that can be helpful in combining policies and designing policy packages.

Two important remarks must be made. Firstly, the analysis does not pretend to analyse the actual policy making, in terms of how intentions are or should be defined, or in terms of how knowledge is or should be applied. The aim is to provide logical distinctions between phenomena, not to provide explanations or prescriptions. Secondly the categories are defined as distinct although they are really only points on several continua.

This typology demonstrates the importance of actors’ situational knowledge, the accuracy and breadth of their causal assumptions and the real and perceived range of their jurisdictional influence. Equally important, it brings the issue of non-intentional effects to the fore; by acknowledging their existence, and by starting to define their characteristics, this analysis affords accounting for them in the early stages of policy design, thus reducing the need to take remedial action at a later date.

The typology is mainly intended for use as part of a broader process of ‘enlightened’ policy assessment, which has a focus on the construction of effective, feasible and acceptable packages of policy measures. The typology can be used to categorize various effects of policies, either ones that have been studied or can be studied ex post, or – more importantly - ones that are being designed.

More specifically the typology can be consulted in the stage of a policy packaging process where a primary measure has been identified and optimized to accomplish its ex ante intended effects. In this consultation process the overall aim should be to identify and seek elimination for possible counter international and secondary effects, as well as to reveal possibly unknown effects. A procedure for this is discussed in TSU et al 2010 and presented in another paper in this conference.
Possible outcomes of the analysis can for example be suggestions to modify the primary measure or to add or remove various additional or compensatory secondary measures proposed.

At this point the typology has not yet been applied outside strictly heuristic exercises and it remains to be seen if it will be helpful. The whole process of policy packaging of which the typology of unintended effects is but a small part, is under development in the OPTIC project (see http://optic.toi.no/).

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