Chapter 20

Adaptive Policymaking for Intelligent Transport System Acceptance

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Introduction

Intelligent Transport System (ITS) implementation is often hindered by the uncertainties that surround implementation (see, e.g., Marchau et al. 2002, van Geenhuizen and Thissen 2002, Walta 2011, van der Pas et al. 2012). Often this uncertainty relates to general public acceptance of the ITS technology, the future acceptance of the technology or the dynamics in acceptance of the technology. (Here we refer to the uncertainty regarding future ITS acceptance among stakeholders due to, for instance, changes in the trade-offs stakeholders make among ITS outcomes and changes in the stakeholder configuration.) Transport policymakers seem paralysed in the face of this uncertainty. Often, this results in the abandonment of implementation of ITS (e.g., the implementation of road pricing in the Netherlands) or a delay in implementation due to the conclusion that more research is needed before a decision can be made (e.g., the numerous trials of Intelligent Speed Adaptation that have been held across the world – see van der Pas, Marchau and Walker 2006). But what should transport policymakers do in situations in which the future is so uncertain that analysts cannot agree upon the right model or have little understanding of what the future will look like? Hereafter, we refer to this type of uncertainty as 'deep uncertainty'.

In this chapter we introduce a policymaking approach that is especially designed to deal with deep uncertainty in developing policies. This approach is called Adaptive

Policymaking (APM). APM is a policymaking approach that was developed at the end of the 1990s at the RAND Corporation in response to the need to cope with deep uncertainty in long-term policymaking for Amsterdam Airport Schiphol (RAND Europe 1997). The approach aims at creating policies that can change over time, as the world changes, and uncertainties about the future are resolved. APM specifies a series of generic steps for decision-making under uncertainty that can be used to design an adaptive policy. The steps in APM are based on the steps of Systems Analysis (Miser and Quade 1985), and key concepts are derived from Assumption-Based Planning (ABP) (Dewar 2002). The potential of APM has been demonstrated by various researchers using transportation cases that reflect real-world policy problems (Agusdinata, Marchau and Walker 2007, Marchau et al. 2008, Agusdinata and Dittmar 2009, Taneja, Ligteringen and Schuylenburg 2010a, Taneja et al. 2010b, Kwakkel, Walker and Marchau 2010, Marchau, Walker and van Wee 2010). However, APM has seen little practical application. Only recently, almost 10 years after the first publication on APM, has attention been given to the practical use of APM (Kwakkel 2010, Walker, Marchau and Swanson 2010, van der Pas 2011).

Why is it important to include a chapter on how transport decision-makers can deal with uncertainty in a book that discusses acceptance issues for ITS technologies? ITS are highly promising when it comes to achieving transportation policy goals (e.g., less emissions, less congestion and a generally safer transport system). However, public acceptance of ITS proves crucial for its implementation and, as such, for contributing to these policy goals. Often the acceptance of the use of ITS (or policies that require the use of ITS, such as road pricing) is deeply uncertain, and in most cases policymakers do not know how, and/or traditional tools are insufficient, to cope with this uncertainty (see, e.g., van der Pas et al. 2006 and van der Pas, Kwakkel and van Wee 2011). This chapter describes a methodology that policymakers can use to overcome the uncertainties that hinder ITS implementation and that can enable them to start to implement ITS despite these uncertainties and the inherently uncertain future.

This chapter answers the question: how can transportation policymakers deal with the deep uncertainty regarding acceptance that surrounds policies aimed at implementing ITS? In particular, in this chapter, we

- explain APM;
- explain how APM can be used to deal with uncertainty regarding acceptance; and
- illustrate how to use APM to design adaptive policies using two real-world ITS examples (one based on desk research, the other based on participative research).

After reading this chapter, a reader will understand what APM is and how to use it. The chapter will also supply the reader with sources to find more information on this subject. In the next section Adaptive Policymaking is introduced and the basic principles are explained. Adaptive Policymaking is then outlined using two cases

– Personal Intelligent Travel Assistance (PITA) and Intelligent Speed Adaptation (ISA). In the final section, the main conclusions are presented.

Adaptive Policymaking

APM is a process of policy design that has five phases: Phase I sets the stage. Phases II, III and IV design the part of the adaptive policy that can be implemented at a certain moment in time (call this $t = 0$). Phase V designs the part of the adaptive policy that is to be implemented at an unspecified time after $t = 0$ (call this $t = 0+$). Figure 20.1 presents the APM process, together with the elements that comprise an adaptive policy. We briefly explain each phase, define each of their elements (policy actions), and elaborate on techniques that could be used to facilitate the
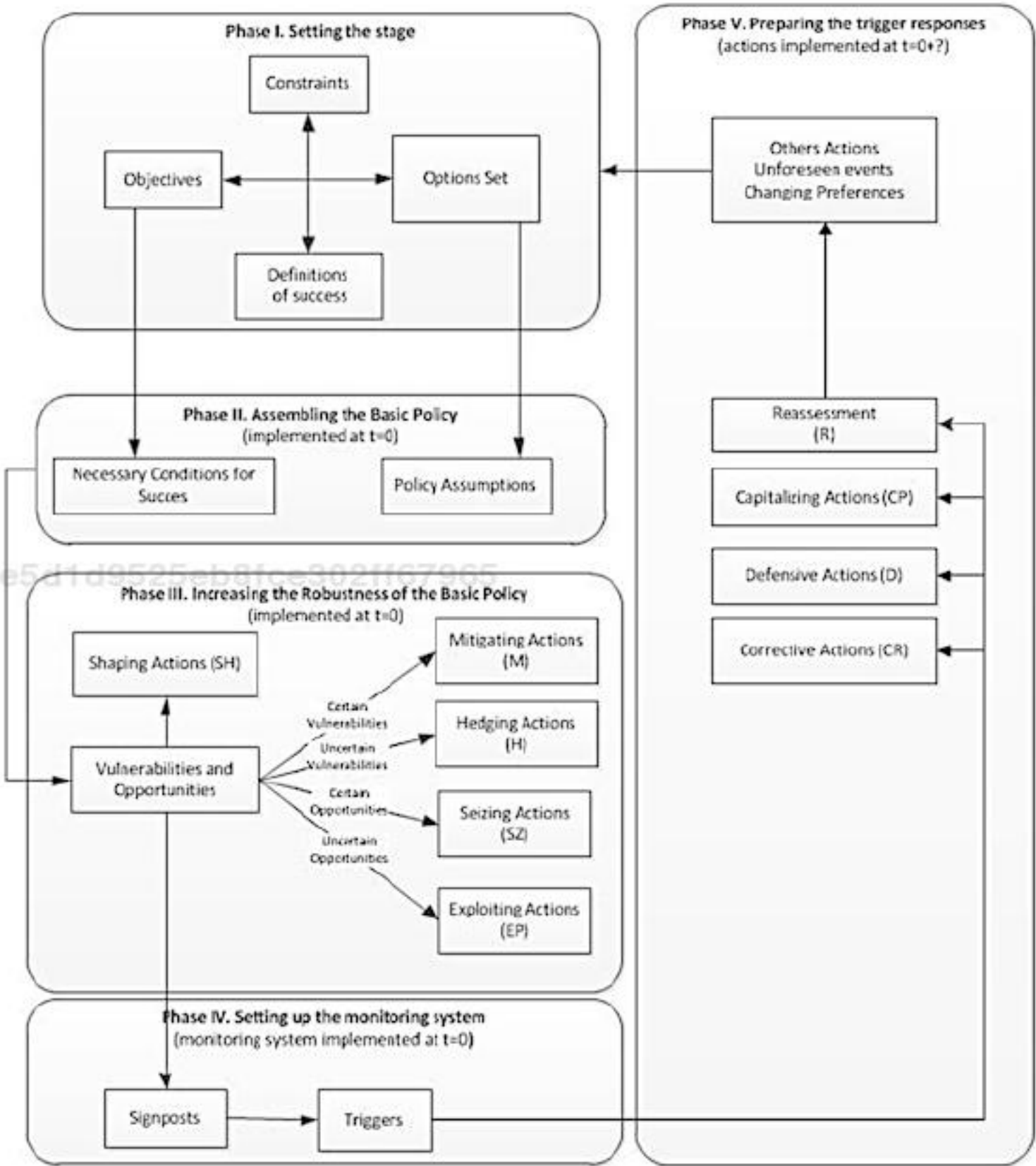
Figure 20.1   The APM process and the elements of an adaptive policy (adapted from Kwakkel 2010)

phase in a workshop setting. For more extensive descriptions and examples of the APM process, see Walker, Rahman and Cave (2001), Kwakkel et al. (2010), van der Pas (2011) and/or Marchau et al. (2008).

Setting the Stage (Phase I) and Assembling the Basic Policy (Phase II)

In this phase, the policy problem is analysed and the goals of the policy are formulated. Setting the stage is an important part of the APM process. The right policy problem has to be identified and formulated, goals and a definition of success have to be specified and a comprehensive list of policy options has to be generated.

Assembling the Basic Policy (Phase II)

Based on an ex-ante evaluation of the policy options identified in Phase I, a promising basic policy is assembled; that is, a promising starting policy. In this phase, the conditions for achieving success are also formulated. The methods in this phase are practically the same as the methods used in traditional ex-ante policy analysis to identify a promising policy (Miser and Quade 1985). In practice, there are many methods that can be used for the ex-ante evaluation of the policy options: for example, cost-benefit analysis (Sassone and Schaffer 1978), multi-criteria analysis (French, Maule and Papamichail 2009) and balanced scorecards (Kaplan and Norton 1993). These assessment techniques can be combined with the results from forecasts, scenarios, models and so on.

Increasing the Robustness of the Basic Policy (Phase III)

This phase and the following phases are designed to make the basic policy adaptive. After selecting a basic policy, the vulnerabilities and opportunities of the basic policy are identified. Vulnerabilities of the basic policy relate to ways in which the basic policy could fail (i.e., violate conditions for success). Opportunities are developments that can increase or accelerate the success of the basic policy (i.e., accelerate conditions for success). The vulnerabilities of the basic policy can be determined by examining the implicit and explicit assumptions that underlie it. Based upon the vulnerabilities and the opportunities, five types of actions can be defined that could be taken at the time the basic policy is implemented (t = 0), in order to increase the chances for its success:

- Mitigating actions (M) – actions aimed at reducing the relatively certain vulnerabilities of a policy;
- Hedging actions (H) – actions aimed at spreading or reducing the risk of failure from the relatively uncertain vulnerabilities of a policy;
- Seizing actions (SZ) – actions aimed at seizing relatively certain available opportunities;
- Exploiting actions (EP) – actions aimed at exploiting relatively uncertain

opportunities; and

- Shaping actions (SH) – actions aimed at reducing the chance that an external condition or event that could make the policy fail will occur, or to increase the chance that an external condition or event that could make the policy succeed will occur.

Setting-Up the Monitoring System (Phase IV)

The actions defined in Phase III are taken in advance to reduce the vulnerabilities of the basic policy and to identify opportunities to improve its chances of success. However, uncertainties about the future require the performance of the basic policy to be monitored carefully in order to know when (and if) to implement actions. This monitoring mechanism is set up in Phase IV by defining what should be monitored (signposts) and when a change in policy is needed (trigger values). Signposts are used to determine whether a defensive, corrective or capitalising action – or even a full policy reassessment – is needed (see Phase V). Implementation of a defensive, corrective or capitalising action, or a policy reassessment, occurs when a critical value of a signpost variable (trigger value) is reached.

Preparing the Trigger Responses (Phase V)

There are four different types of actions that can be triggered by a signpost:

- Defensive actions (D) – actions aimed at clarifying the basic policy, preserving its benefits or meeting outside challenges in response to specific triggers. These actions leave the basic policy unchanged;
- Corrective actions (CR) – actions aimed at adjusting the basic policy;
- Capitalising actions (CA) – actions triggered by external developments that improve the performance of the basic policy; and
- Reassessment (R) – an action that is initiated when the analysis and assumptions critical to the plan's success have clearly lost validity.

These actions are designed in Phase V. Once the basic policy and adaptive elements are agreed upon, the actions from Phases I–IV are implemented (at t = 0); the actions for Phase V are prepared but their implementation is suspended until a trigger event occurs.

Applying APM to the Implementation of a Personal Intelligent Travel Assistant

The Personal Intelligent Travel Assistant (PITA)

A major objective for transport policies is the efficient use by travellers of the existing transport infrastructure capacity. Although travel information through

radio, television, the Internet etc., is widely available, its effectiveness is low, since those travellers that are offered alternative routes/modes generally do not accept them (Muizelaar 2011, Dicke 2012).

Therefore, a mobile phone-based travel information service has been developed that provides travellers with a full overview of travel options for travelling in the most efficient and effective way from a specific origin to a specific destination. This so-called Personal Intelligent Travel Assistant (PITA) has recently become available, but implementation is proceeding very slowly. So far, policymaking on PITA has been limited to supporting research and development designed to reduce the uncertainty in the outcomes of a PITA. In particular, the behavioural response of travellers to advanced travel information has been researched in depth (for an overview, see Chorus, Molin and van Wee 2006). Although useful, assumptions in most of these studies include the continuous availability of necessary traffic information, a perfectly functioning technology and a rational traveller. These assumptions with respect to the traveller response to PITA are unlikely to be valid. In any event, they are insufficient for PITA implementation to proceed. Instead of additional research and development on reducing the uncertainty of the outcomes, implementation of PITA could be sped up by developing an adaptive policy that takes into account the full range of uncertainty and modifies the basic policy based on what is learned over time.

Designing an Adaptive Policy Using Desk Research

The following subsections show how an adaptive policy for PITA implementation was designed using desk research and existing information. More information on methods and tools that can be used to design adaptive policies can be found in van der Pas (2011).

Phase I (Setting the Stage) and Phase II (Assembling the Basic Policy)

In Phase 1 of developing an adaptive policy for PITA implementation, important constraints would be financial and a requirement that the achievement of other transport policy objectives (e.g., safety, environmental stress) not be made more difficult due to the implementation of PITA. A definition of success might be a pre-specified improvement in (the reliability of) travel times. For instance, national policy objectives in the Netherlands include that, in 2020, 95 per cent of all movements by road should be on time during rush hours, and 90 per cent of all trains should be on time (Ministry of Transport, Public Works and Water Management 2000). Several alternative PITA options can be specified for consideration in Phase II.

In Phase II, a basic policy might be to implement PITA first for those individuals who have high demands on their time – for example, for professional drivers and business travellers (Polydoropoulou and Ben-Akiva 1998, Bovy 2001). These travellers are likely to be the most willing to adopt PITA since, by definition,

they are the sub-group that is most affected by travel time losses and unreliability. Basic conditions for success include the willingness of key actors (e.g., road traffic managers, public transport operators) to provide reliable and accurate travel information, the availability of integrated models to combine multimodal travel data to meet individual preferences and the willingness of professional drivers and business travellers to buy and use PITA.

Phase III (Increasing the Robustness of the Basic Policy) and Phase IV (Setting Up the Monitoring System)

In Phase III, the several vulnerabilities of this basic policy are identified. A certain vulnerability might be a temporary lack of travel data availability for certain modes. This will likely affect the user acceptance of PITA. A mitigating action might be to include a backup travel information system that travellers can use in case of a temporary blackout. Another certain vulnerability would be that travellers resist the willingness to buy PITA because it affects their privacy; that is, it seems like 'Big Brother' watching their travel behaviour. Some travel-data encoding that avoids personal identification in relation to travel choices can be used to mitigate this vulnerability. An uncertain vulnerability involves the user acceptance of PITA – in particular, whether the PITA advice will be followed by travellers (Bonsall 2004). A signpost can be constructed that monitors the level of PITA use. As soon as the level of use drops under a predefined level (trigger), some corrective action might be initiated, such as advertising or educating travellers on the advantages of using PITA when travelling. This is related to another uncertain vulnerability – the willingness of key actors to cooperate on implementing PITA due to, for instance, too large investment risks for (public and/or private) transport operators. A hedging action might be that, at the beginning, public policymakers give some insurance for companies against potential investment losses.

Phase V (Preparing the Trigger Responses)

Once the above policy is agreed upon, the basic PITA policy plus the Phase III and Phase IV actions are implemented, and signpost information begins to be collected (see Table 20.1). In the case of a trigger event, the related prepared action is undertaken. If, for instance, the number of travellers following the PITA advice appears to be too low, some corrective action can be undertaken – for example, giving some financial incentive to those travellers who do comply with the PITA advice. For some trigger events, only a full reassessment of the basic policy might be sufficient. In case some of the key actors are not willing to participate anymore (e.g., if the returns on investment remain too low), the entire policy might come under serious pressure. However, the knowledge gathered in the initial policymaking process on outcomes, objectives, measures, preferences of stakeholders and so on would already be available and would accelerate the new policymaking process.

Table 20.1   Dealing with vulnerabilities of the basic PITA policy

Vulnerabilities	Mitigating/hedging actions	Possible signposts/triggers/actions
Certain: (temporary) lack of travel data availability	Mitigating action: • Provide backup travel information system	
Certain: Willingness of travellers to buy PITA due to, e.g., privacy reasons, individual cost-benefit trade-offs	Mitigating actions: • Provide travel-data encoding ensuring privacy of travellers • Give (financial) incentives to travellers for buying PITA	
Uncertain: Willingness of professional drivers and business travellers to use PITA	Hedging action: • Explain advantages of PITA use to target groups	Monitor the level of PITA use. In case of too low usage (trigger), implement corrective action (e.g., provide incentives to travellers for using PITA; expand basic policy to other target groups).
Uncertain: Willingness of key actors to cooperate on implementing PITA	Hedging action: • Provide insurance for PITA companies against potential investment losses	Monitor the level to which key actors are willing to cooperate on implementing PITA. In case cooperation appears insufficient, a total reassessment of the adaptive policy is needed.

Applying APM to ISA Implementation

Intelligent Speed Adaptation in the Netherlands

Intelligent Speed Adaptation (ISA) systems are in-vehicle devices that take into account the local speed limits and warn the driver in case of speeding; some even automatically adjust the maximum driving speed to the posted maximum speed. Since speeding is the major cause of traffic accidents – roughly a third of all fatal accidents are due to inappropriate speed choice (OECD 2006) – the potential contribution of ISA to traffic safety is high. For instance, fully automatic

speed control devices are estimated to produce up to a 40 per cent reduction in injury accidents (Várhelyi and Mäkinen 2001) and up to a 59 per cent reduction in fatal accidents (Carsten and Tate 2000). Recently, the first ISA applications have entered the market. Speed-limit information is being added to digital maps, so drivers can be warned about speeding by their navigation device using audiovisual signalling (this is called warning ISA).

So the ISA technology is available and there is experience with using it. Although expectations concerning the positive impacts of ISA are high, there still is a considerable gap between what is technologically possible and what has been implemented so far. The implementation of ISA is hindered by various deep uncertainties, including uncertainty about the way users might respond to ISA. In this case, an adaptive policy for ISA implementation was developed with ISA experts, policymakers and stakeholders during a workshop.

Phase I (Setting the Stage) and Phase II (Assembling the Basic Policy)

Important constraints for developing an adaptive policy for ISA implementation would be financial and the requirement that other transport policy objectives (e.g., safety, environmental stress) are not made more difficult to achieve due to the implementation of ISA. A definition of success in general terms would relate to the improvement of traffic safety (e.g., a reduction of 10 per cent in the number of fatalities). Based on the selected basic policy, the definition of success and the constraints have been operationalised in Table 20.2. Following interviews with policymakers from the Dutch Ministry of Infrastructure and Environment and existing policy plans, we adopted a basic policy aimed at implementing the most appropriate ISA for the most appropriate type of driver. Three types of drivers were distinguished:

- *The well-meaning driver*: This type of driver has the intrinsic motivation to stick to the speed limit;
- *The less well-meaning driver*: This type of driver lacks the intrinsic motivation to stick to the speed limit; and
- *The notorious speed offender*: Under the current regime, this type of driver would lose his or her driver's licence (and would be obliged to follow a traffic behaviour course).

In addition to different types of drivers, two different sequential phases for the implementation of ISA were identified. Phase I runs up to 2013. After 2013, a currently undefined Phase II will start. Table 20.2 presents an overview of the basic policy.

Table 20.2   Basic policy for the ISA case

Basic policy				
Type of driver	Type of ISA	Measure	Definition of success	Constraints
Phase I (2009–2012)				
Well-meaning driver	Warning ISA or speed alert	Start a campaign aimed at persuading people to turn on the speed alert functionality on their navigation device. Make agreements with companies that develop navigation devices.	Before 2013: 50% of the people that own and use a navigation device actively use the speed alert functionality.	Budget for a campaign
Less well-meaning driver (But also covers the well-meaning driver)	Free to be selected	Develop a business case with insurance companies and leasing companies.	Before 2013: 50% of the car owners and 50% of leased car drivers can choose insurance or a lease product that involves ISA.	
Notorious speed offender	Restricting	Perform a pilot test aimed at assessing the effects of implementing a restricting ISA for notorious speed offenders. Make an evidence-based decision regarding implementation of such a system for notorious speed offenders.	Before 2013: A decision has to be made on implementation of ISA for notorious speed offenders (based on, amongst others things, outcomes of the trial).	Budget/time
Phase II (2013): Phase II will be dependent on the results of Phase I. For this phase, more restricting types of ISA will be considered.				

As can be seen in Table 20.2, making a practical distinction between well-meaning and less well-meaning is not needed, because both groups are targeted with the same policies. However, it is expected that the measures would have a different effect on each of the target groups. (Notorious speeders can be defined based on past behaviour.)

Phase III (Increasing the Robustness of the Basic Policy)

The vulnerabilities and opportunities of the basic policy were specified using a Strengths, Opportunities, Weaknesses and Threats (SWOT) analysis structure

(Ansoff 1987). In our case, we considered both the opportunities and strengths to be opportunities as defined in Figure 20.1, and considered both the weaknesses and threats to be vulnerabilities as defined in Figure 20.1. This resulted in a list of more than 100 different opportunities and vulnerabilities for the basic policy. According to the participants, the most important of these relate to acceptance, technical functioning of ISA systems, the relationship between technical functioning and acceptance and the relationship between technical functioning and driver behaviour (for a full overview, see van der Pas 2011).

Next, the level of uncertainty and level of impact for each of the most important opportunities and vulnerabilities were identified and the participants were tasked to define actions for handling these. The process included ranking techniques and specially designed decision-making flowcharts (see van der Pas 2011). Table 20.3 presents a subset of Phase III actions that were generated during the workshop. (The complete set can be found in van der Pas 2011.)

Table 20.3   Increasing the robustness of the basic policy

Vulnerabilities and opportunities (certain or uncertain)	Actions: hedging (H), mitigating (M), seizing (SZ), exploiting (EP) and shaping (SH)
Implementing a restricting ISA for notorious speed offenders will damage the image of the less intervening ISA systems. ISA will be associated with punishment, not with assistance (like it is now). **(uncertain)**	**H**: Decouple the pilot from the rest of the basic policy and avoid the term 'ISA' (currently done by calling it speed-lock).
The availability of an accurate speed-limit database. Speed-limit data have to match the time (dynamic), location and vehicle. **(certain)**	This is a critical success factor, so **M**: Define who is responsible for what before starting with implementation; **M**: Tender the development of a speed-limit database (this should be arranged by public authorities); **M**: Guarantee quality through a third party that is under the supervision of the public authorities; **M**: Develop a system based on beacons that can overrule the static speed-limit information (failsafe design).
Automotive lobby to prevent large-scale implementation of ISA. **(uncertain)**	**H**: Include the automotive industry in the implementation strategy.
Speed-limit data become more and more dynamic. **(certain)**	**M**: Implement ISA systems that will function well when this happens (for instance, systems that allow for communication with the infrastructure, to transmit temporary speed limits, e.g., Bluetooth, Wi-Fi).

Cars and ISA draw lots of attention and appeal to peoples' emotions. Instead of seeing this as a threat, this can be used as an opportunity. **(uncertain)**	**SH**: Invite stakeholders that exhibit these feelings to participate in improving and implementing ISA (e.g., the presenters of Top Gear, racing drivers, etc.).
People/companies are more willing to adopt technology if they can see the technology in practice. Creating a pool of cars that are equipped can result in an uptake of the technology. **(uncertain)**	**SH**: Practice what you preach. Let the Ministry themselves equip their fleet with ISA and practice an example function. Prove that it significantly reduces the number of accidents and as such results in fewer claims.

Phase IV (Setting-Up the Monitoring System) and Phase V (Preparing the Trigger Responses)

Next, actions, signposts and triggers were designed (also using specially designed decision-making flowcharts (see van der Pas 2011). A subset of these actions, signposts and triggers is shown in Table 20.4.

Table 20.4   Contingency planning, monitoring system and trigger responses

Vulnerabilities and Opportunities	Monitoring and triggering system	Actions: reassessment (R), corrective (CO), defensive (D) and capitalising (CA)
Implementing a restricting ISA for notorious speed offenders will damage the image of the less intervening ISA systems. ISA will be associated with punishment, not with assistance (like it is now).	• Number of negative press publications • Level of acceptance of different ISA systems • Number and type of ISA-related questions asked in the politicians in the Lower House	**D**: Media campaigns to manage the perception of people regarding ISA (and the speed-lock); explain the difference between the two systems, and the need for implementing restricting ISA for this type of driver
The availability of an accurate speed-limit database. Speed-limit data have to be correct for the right time (dynamic), the right location and the right vehicle.	• Level of accuracy/reliability of speed-limit database	Changes in accuracy should be monitored over time. In addition, **D**: Start making it more accurate; **CO**: Stop implementation of certain types or combine with on/off switch and overruling possibilities; **CO**: Design the system in such a way that it only warns/intervenes in areas with certain accuracy levels.

Technology can fail: location determination can be inaccurate (e.g., in tunnels, in cities with high buildings); systems can stop functioning (sensors fail, etc.).	• Cause of accidents (relationship ISA – cause of accident) • Press releases on ISA and accidents	**D**: Make sure the market improves the systems (adjust implemented rules and regulations regarding system functioning). **R**: When large-scale failure occurs or the effects are drastic (ISA implementation leads to fatalities).
Speed limit data become more and more dynamic.	• Availability of dynamic speed limits	**D**: Make sure road authorities equip new dynamic speed limit infrastructure with infra-to-vehicle communication (so in-vehicle systems can be easily adjusted). **D**: Standardisation of communication protocol and communication standard
ISA implementation can result in larger cost savings than expected: lower and more homogeneous speeds => lower consumption costs (fuel savings + lower maintenance), resulting in higher levels of acceptance.	Monitor additional effects of implementation on: • emissions; • fuel use; and • throughput/congestion.	**CA**: Upscale the number of participating insurance companies. **CA**: Use this information in the business case for new insurance and lease companies.

The centre column of Table 20.4 can be transformed into a list of indicators that should be monitored: 'the monitoring system'. This monitoring system consists of signposts that measure the progress towards the goal (i.e., success), and signposts that are directly related to the vulnerabilities and opportunities.

Phase V (Preparing the Trigger Responses)

The workshop resulted in the development of an extensive adaptive policy, including a total of 26 mitigating actions, 16 defensive actions, three reassessment actions, two capitalising actions and two seizing actions. In practice, once the basic policy and all its adaptive elements have been agreed upon, the basic ISA implementation policy (Table 20.2) plus the Phase III and Phase IV actions would be implemented and signpost information would begin to be collected (see Tables 20.3 and 20.4). In case of a trigger event, the related (already prepared) action would be undertaken.

The Result

The designed policy was tested using wildcard scenarios, in order to determine how robust it might be. One example of a wildcard scenario is after ISA is implemented, industry starts to develop equipment that misleads the ISA systems, allowing people to speed without the system noticing. The participants were asked to think about 'what if' such a wildcard scenario were to occur. In particular, for each scenario, they were asked to answer the following questions:

- What would happen to the (road) transport system?
- What would happen to your policy, and how would the outcomes of the policy be influenced if this scenario were to occur?
- Is your adaptive policy capable of dealing with this scenario?

These wildcard scenarios led to interesting (and lengthy) discussions, which allowed the participants to reflect on the developed adaptive policy, assess its robustness and improve it.

The participants' evaluation of the workshop indicated that the resulting adaptive policy was ready to be implemented and could, if implemented, really contribute to a successful ISA policy (see van der Pas et al. 2011).

Conclusion

In this chapter, we introduced a relatively new approach that allows transportation policymakers to deal with the uncertainties that surround the implementation of ITS technologies. Based on two examples, the chapter shows that APM is an approach that allows policymakers to deal with (amongst others) issues of acceptance, and should allow them to speed-up the implementation of ITS technologies.

Two adaptive policies were designed, one for PITA based on desk research and one for ISA based on a participative workshop with ISA stakeholders. The basic PITA policy is designed for those drivers that could benefit most from PITA. The basic ISA policy is designed to implement different types of ISA for different types of drivers. Both policies would begin with the use of the ITS systems by small subsets of transport users. Both would offer the possibility of modifying the policy gradually as more information regarding acceptance becomes available (based on monitoring acceptance). This approach would allow for implementation to begin right away, for policymakers to learn over time and for the policy to be adjusted in response to new developments.

A lot of research has been performed on ISA and PITA acceptance. The time has come to begin implementation. APM is an approach that allows policymakers to deal with (amongst others) issues of acceptance, and should allow them to speed-up the implementation of ITS technologies.

References

Agusdinata, D.B. and Dittmar, L. 2009. Adaptive policy design to reduce carbon emissions, a system-of-systems perspective. *IEEE Systems Journal*, 13(4): 509–19.

Agusdinata, D.B., Marchau, V.A.W.J. and Walker, W.E. 2007. Adaptive policy approach to implementing intelligent speed adaptation. *IET Intelligent Transport Systems*, 1(3): 186–98.

Ansoff, H.I. 1987. *Corporate Strategy*. Harmondsworth, Middlesex, UK: Penguin Books.

Bonsal, P. 2004. Traveller behavior: Decision-making in an unpredictable world. *Journal of Intelligent Transportation Systems: Technology, Planning, and Operations*, 8(1): 45–60.

Bovy, P. 2001. Traffic flooding the low countries: How the Dutch cope with motorway congestion. *Transport Reviews*, 21(1): 89–116.

Carsten, O.M.J. and Tate, F.N. 2000. *Final report: Integration, Deliverable 17 of External Vehicle Speed Control Project*. Leeds: University of Leeds, Institute for Transport Studies.

Chorus, C.G., Molin, E.J.E. and van Wee, G.P. 2006. Travel information as an instrument to change car-drivers' travel choices: A literature review. *European Journal of Transport and Infrastructure Research*, 6(4): 335–64.

Dewar, J.A. 2002. *Assumption-Based Planning: A Tool for Reducing Avoidable Surprises*. Cambridge: Cambridge University Press.

Dicke, M. 2012. *Psychological aspects of travel information presentation*. Delft, the Netherlands: TRAIL Thesis Series, T2012/5.

French, S., Maule, J. and Papamichail, N. 2009. *Decision Behaviour Analysis and Support*. Cambridge: Cambridge University Press.

Kaplan, R.S. and Norton, D.P. 1993. Putting the balanced scorecard to work. *Harvard Business Review*, 71(5): 134–47.

Kwakkel, J.H. 2010. *The treatment of uncertainty in airport strategic planning*. Delft, the Netherlands: TRAIL Thesis Series, T2010/13.

Kwakkel, J.H., Walker, W.E. and Marchau, V.A.W.J. 2010. Adaptive airport strategic planning. *European Journal of Transportation and Infrastructure Research*, 10(3): 227–50.

Marchau, V.A.W.J., Walker, W.E. and van Duin, R. 2008. An adaptive approach to implementing innovative urban transport solutions. *Transport Policy*, 15(6): 405–12.

Marchau, V.A.W.J., Walker, W.E. and van Wee, G.P. 2010. Dynamic adaptive transport policies for handling deep uncertainty. *Technological Forecasting and Social Change*, 77(6): 940–50.

Marchau, V.A.W.J., Wiethoff, M., Hermans, L., Meulen, R. and Brookhuis, K.A. 2002. *Actor Analysis Intelligent Speed Adaptation*. Final Report No. AV-5157. Delft/Wijk en Aalburg.

Ministry of Transport, Public Works and Water Management. 2000. *The National Traffic and Transport Plan*. The Hague.

Miser, H.J. and Quade, E.S. 1985. *Handbook of Systems Analysis: Overview of Uses, Procedures, Applications, and Practice*. New York: Elsevier Science.

Muizelaar, T.J. 2011. *Non-recurrent traffic situations and traffic information*. Delft, the Netherlands: TRAIL Thesis Series, T2011/16.

Organization for Economic Cooperation and Development (OECD). 2006. *Speed Management*. Paris: OECD.

Polydoropoulou, A. and Ben-Akiva, M. 1998. The effect of advanced traveler information systems (ATIS) on travelers' behavior. In: Behavioral and Network Impacts of Driver Information Systems. Emmerink, R.H.M. and Nijkamp (Eds.), 317–52, Aldershot, Ashgate.

RAND Europe. 1997. *Scenarios for Examining Civil Aviation Infrastructure Options in the Netherlands*. Report DRU-1512-VW/VROM/EZ. Santa Monica, CA: RAND.

Sassone, P.G. and Schaffer, W.A. 1978. *Cost-Benefit Analysis: A Handbook*. San Diego, CA: Academic Press.

Taneja, P., Ligteringen, H. and van Schuylenburg, M. 2010a. Dealing with uncertainty in design of port infrastructure systems. *Journal of Design Research*, 8(2): 101–18.

Taneja, P., Walker, W.E., Ligteringen, H., van Schuylenburg, M. and van der Plas, R. 2010b. Implications of an uncertain future for port planning. *Maritime Policy and Management*, 37(3): 221–45.

van der Pas, J.W.G.M. 2011. *Clearing the road for ISA implementation? Applying adaptive policymaking for the implementation of intelligent speed adaptation*. Delft, the Netherlands: TRAIL Thesis Series, T2011/13.

van der Pas, J.W.G.M., Kwakkel, J.H. and van Wee, B. 2011. Evaluating adaptive policymaking using expert opinions. *Technological Forecasting and Social Change*, 79(2): 311–25.

van der Pas, J.W.G.M., Marchau, V.A.W.J. and Walker, W.E. 2006. *An Analysis of International Public Policies on Advanced Driver Assistance Systems*. Presented at the 13th World Congress and Exhibition on Intelligent Transport Systems and Services, London.

van der Pas, J.W.G.M., Marchau, V.A.W.J., Walker, W.E., van Wee, G.P. and Vlassenroot, S.H. 2012. ISA implementation and uncertainty: A literature review and expert elicitation study. *Accident Analysis and Prevention*, 48: 83–96.

van Geenhuizen, M. and Thissen, W. 2002. Uncertainty and intelligent transport systems: Implications for policy. *International Journal for Technology, Policy and Management* 2(1): 5–19.

Vårhelyi, A. and Mäkinen, T. 2001. The effects of in-car speed limiters: Field studies. *Transportation Research Part C: Emerging Technologies*, 9(3): 191–211.

Walker, W.E., Marchau, V.A.W.J. and Swanson, D. 2010. Addressing deep uncertainty using adaptive policies: Introduction to section 2. *Technological Forecasting and Social Change*, 77(6): 917–23.

Walker, W.E., Rahman, S.A. and Cave, J. 2001. Adaptive policies, policy analysis, and policymaking. *European Journal of Operational Research*, 128: 282–9.

Walta, L. 2011. *Getting ADAS on the road – Actors' interactions in advanced driver assistance systems deployment*. Delft, the Netherlands: TRAIL Thesis Series, T2011/4.