

15. Mission-oriented innovation policy: the case of the Swedish “Vision Zero” approach to traffic safety¹

Jannes Craens, Koen Frenken and Toon Meelen

MISSION-ORIENTED INNOVATION POLICY

Innovation policy, in part, consists of mission-oriented policies that direct the efforts of multiple actors towards reaching a concrete goal. The notion of mission refers to NASA’s mission to put a man on the moon in the 1960s. The achievement of this goal could obviously not be left to the market nor to scientists alone. Instead, a dedicated organization needed to be created bringing together a diverse set of expertise with strong political backing. A similarly successful example of mission-oriented innovation policy has been the development of high-speed trains by the French government in the late 1970s.

Mission-oriented innovation policy is currently making a revival (Mazzucato, 2018; Schot and Steinmueller, 2018), including in the context of transport innovation (Bugge et al., 2021). This revival is motivated by the need to address today’s grand societal challenges, notably global warming, biodiversity loss, and ageing populations. Contrary to the past missions which were characterized by a technological challenge, today’s missions are motivated by societal challenges. Most prominently, global warming is threatening the livelihoods of millions of people. Similarly, biodiversity loss and chemical pollution is affecting food production and human health in a myriad of ways. To tackle these challenges, production and consumption will need to change drastically. Apart from challenges of an environmental kind, there are other societal challenges often noted by politicians, including cybersecurity, obesity, ageing, and mental health.

While these societal challenges are all quite different, they have in common that the problems that need to be tackled are “wicked” (Wanzenböck et al., 2020). Wicked problems are characterized by:

- *contestation*, resulting from divergent claims, values, and framings;
- *complexity*, resulting from the multitude of relevant actors and geographical scales (local, national, global) causing a “problem of many hands” (Thompson, 1980);
- *uncertainty*, resulting from limited knowledge to develop effective policies.

Traditional innovation policies are considered to be unfit to deliver solutions to wicked problems. In most high-income countries, traditional innovation policies focus on supporting innovative firms, in particular by subsidizing R&D personnel, stimulating collaboration with universities, and granting the firms patent protection (Schot and Steinmueller, 2018; Wanzenböck et al., 2020). However, as there is no well-developed market for societal problems (being externalities or insufficient public goods), firms are unlikely to develop effective solutions to them. Instead, government itself may have to take the lead.

For governments to be effective in mission-oriented innovation policy, they must avoid a number of pitfalls. In this context, Weber and Rohracher (2012) argued that a new type of innovation policy is needed that is “transformative”. Rather than leaving it to firms to develop innovation within the context of existing markets and regulations, government should take the lead in providing “directionality” to innovative activities – including those by firms – so as to transform society. One type of transformative innovation policy is the use of missions: setting a bold and well-defined goal and providing funds and a policy mix to reach such a goal. A policy mix here refers to a combination of policy instruments. The articulating of what is called a “mission” can guide the creativity and investments of many different actors in a particular direction. The key example today is innovation policy in the energy domain, following the target set for countries in the Paris Agreement from December 2015 (to limit global warming to below 2 degrees Celsius, preferably to 1.5 degrees Celsius).

To tackle societal challenges, it is not just about coming up with innovative solutions, but also about having these solutions diffuse within society. Hence, mission-oriented innovation policy involves a much broader policy mix than traditional innovation policy as it focuses not only on innovation but also on diffusion, involving stimulating new markets (e.g., by public procurement or product subsidies), the development of new regulations and standards (e.g., regarding the phasing out of harmful technologies or minimum performance standards), and inducing behavioral change (e.g., through information campaigns and training schemes). As so many policies are needed at the same time, a key aspect of mission-oriented innovation policy is to provide coordination among ministries and between government levels (municipality, province, state, Europe) (Hekkert et al., 2020; Larrue, 2021).

While there is an increasing consensus among policy makers and academics that mission-type policies are needed to tackle the grand societal challenges

of our time (Schot and Steinmueller, 2018; Wanzenböck et al., 2020; Larrue, 2021), there is little experience in actually carrying out such ambitious policies. While there has been some experience with technological missions – such as the aforementioned man-on-the-moon and high-speed train projects – the lessons learned from technological challenges do not necessarily carry over to societal challenges. Technological challenges are not so wicked as societal challenges, as there is a clear technological goal for which a dedicated organization can be created under government control. Instead, in the case of missions for societal challenges, the articulation of the mission itself is an important process in its own right. The articulation of the mission, and follow-up policies, should then mobilize a variety of actors in a distributed manner rather than within a single government organization. If this process of “demand articulation” involves relevant actors, has broad political support, and is clearly defined and measurable, the formulation of the mission reduces the wickedness. The policy can then set in motion a coordinated and reflexive process among various actors (Hekkert et al., 2020; Wanzenböck et al., 2020).

While mission-oriented innovation policy towards societal challenges has emerged very recently, we may still learn from policies in the past that – with hindsight – can be understood as policies with a societal mission. In the Netherlands, for example, the persistent challenge to avoid massive flooding has led to a new type of water policy that involves controlled flooding of designated areas (van Staveren et al., 2014). Other examples include re-structuring polluted areas (Coenen et al., 2018) and anti-smoking policies (Wanzenböck et al., 2020).

Here, we report on Sweden’s ambitious traffic safety policy known as “Vision Zero”. We consider this policy as a mission-oriented innovation policy towards a societal challenge, as it started from the articulation of a bold, societal goal (zero traffic deaths) and involved all sorts of innovations from a variety of actors (public, private, and professional organizations). This chapter first explains what the Vision Zero policy entails and then investigates the factors that made it a success as well as the policy failures that were not overcome. We then draw lessons for the development of new mission-oriented innovation policies to address societal challenges in transport. The research was based on 14 interviews with key people involved in the policy over the years, including employees at Trafikverket, the governmental body that works on Swedish road traffic infrastructure and safety, employees in other governmental bodies, and employees at private firms connected to Vision Zero. As part of the interview series, we also had conversations with two fellow academics from Sweden with expert knowledge on Vision Zero.²

VISION ZERO

Vision Zero is a traffic safety policy introduced by the Swedish government in 1997 (Ministry of Transport and Communications, 1997). The objective of the Vision Zero policy holds that “eventually no one will be killed or seriously injured within the road transport system” (Tingvall and Haworth, 1999, p. 1). While a specific time-span is not provided to reach the goal of zero, the vision was introduced with a long time-span in mind (Belin et al., 2012). Its long-term orientation, as well as ambitious aim to bring fatalities to zero, set the policy apart from different traffic safety policies (Johansson, 2009). Before Vision Zero, traffic safety policies were built around reducing fatalities or centered around new innovations that could prevent them. As a defining characteristic, the Vision Zero policy does not start from the supply of possible solutions (thus asking “what *can* be done?”), but rather starts from the demand articulation of zero deaths (asking then “what *should* be done?”). With its use of a mission for dealing with societal problems, Vision Zero is considered not just a new traffic policy, but also a policy innovation as such (Belin et al., 2012; Belin and Tillgren, 2013).

The use of explicit quantitative goals was not new in Swedish traffic safety policy. From 1982, goals were established by the Swedish government regarding fatalities in road traffic accidents (Belin et al., 2010). The main policy change of Vision Zero in this regard was its ethical basis. The ethical principle underlying Vision Zero holds that “It can never be ethically acceptable that people are killed or seriously injured when moving within the road transport system” (Tingvall and Haworth, 1999). The policy thus reoriented priorities from preventing accidents in general to preventing accidents resulting in serious injuries or deaths. This also means that investments in traffic safety policy are not evaluated using a cost–benefit analysis, where the return on investment is computed by aggregating all effects using monetary valuations, including the valuation of people’s lives as well as of travel time (which may increase as a result of safety investment).

Two explicit ethical rules in Vision Zero have been highlighted (Tingvall and Haworth, 1999, p. 2). First, “life and health can never be exchanged for other benefits within the society”. This principle breaks with cost–benefit analysis that treats traffic fatalities as any other externality so as to include the social costs of traffic fatalities in the total of costs and benefits of investments in road infrastructure. As a second rule, it is stated that “whenever someone is killed or seriously injured, necessary steps must be taken to avoid a similar event”. This principle ensures that traffic safety policy is a continuous process of learning.

Alongside the ethical approach of the policy, the responsibility of the road users and designers of the road systems was changed in three main aspects that differ greatly from other road traffic systems (Tingvall and Haworth, 1999, p. 1):

- “The designers of the system are always ultimately responsible for the design, operation and use of the road transport system and thereby responsible for the level of safety within the entire system.”
- “Road users are responsible for following the rules for using the road transport system set by the system designers.”
- “If road users fail to obey these rules due to lack of knowledge, acceptance or ability, or if injuries occur, the ‘system designers’ are required to take necessary further steps to counteract people being killed or seriously injured.”

The key change here is that the responsibility for safety is not fully centered on the road user, as in traditional road safety systems, but that “system designers” also carry responsibility. System designers are defined as organizations that have responsibilities related to the design and maintenance of the elements of the road system (such as vehicles and roads), as well as to the support systems enabling safe road traffic, such as regulation and education (Fahlquist, 2006; Rosencrantz et al., 2007). In particular, they should design traffic systems in such a way that road users’ mistakes do not result in serious or fatal injuries. Hence, this change does not mean that less responsibility is placed on road users. Rather, given that road users – being human – make mistakes, system designers carry the responsibility to make sure that such mistakes do not lead to major injuries.

This engineering challenge was further elaborated by setting the physical abilities of humans to withstand crash impact central in the design of the traffic system. These factors are taken up in the ability of a vehicle to withstand an accident and the forgivingness of road infrastructure. The combined scientific knowledge on these aspects was used as a starting point for the design of traffic systems, in particular road infrastructure and car design.

One example of an innovation that resulted from these principles is the “2 + 1 road”, with a barrier which is now a standard design in Sweden on new roads where speeds are over 70km/h (Figure 15.1). The barrier is erected in the middle of a 2 + 1 road, which has two lanes in one direction and one in the other. This wired barrier prevents head-on collisions between opposing drivers, which often have severe consequences. It is considered extremely effective, lowering fatalities by up to 80 percent (Johansson, 2009). Besides safety improvements, this type of road is also a less expensive alternative to four lane roads, while enabling almost the same traffic flow.



Source: Skvatram (2007).

Figure 15.1 Example of 2 + 1 road in Sweden

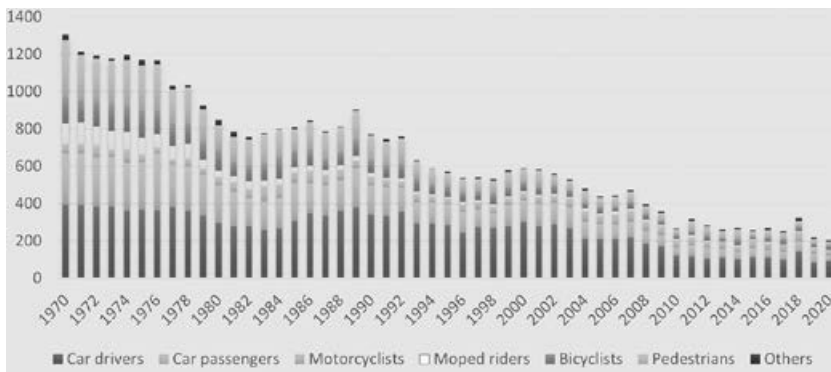
Another practical outcome is the use of roundabouts. Roundabouts are usually not effective in reducing the number of accidents, but ensure that when one occurs, the impact is much lower. Because of lower speed levels they can ultimately contribute to a reduced number of fatalities (Belin et al., 2012). Besides these measures, attention has been paid to improving safety conditions for unprotected road users, leading to widespread implementation of separated bike lanes among other measures. Another important focus of improvements is on vehicle design so as to address irresponsible driver behavior. One of the innovations is the “alcolock”, a device which ensures the driver can only start a vehicle when sober. This solution is especially used with people who are professional drivers, such as taxi drivers and bus drivers, or have a history with intoxicated driving (Johansson, 2009). Furthermore, seatbelt reminders have been developed, which provide warnings to drivers when seatbelts are not worn. To stimulate vehicle innovation, the government takes a leading role by procuring cars that are equipped with the most recent safety features. Herewith, it contributes to faster and more widespread diffusion (Belin et al., 2012).

Another distinctive example is the use of so-called “safety cameras”. These speed cameras are installed on roads which have a high record of injuries or fatalities but lack possibilities to take other measures such as median barriers. To encourage social acceptance of cameras, they were redesigned in the early 2000s, making them round and partly blue, the color used for traffic infor-

mation. A concurrent campaign was launched on “Sweden’s new lifesavers”. The number of speed tickets issued is confined to a set yearly amount, which practically means that every camera is only operational for 10 percent of the time (Lindberg and Håkansson, 2017). While ticketing is limited, the cameras do generate continuous data, enabling road operators to learn lessons about effectiveness. These various aspects of camera implementation enabled lowering speeds on large stretches of roads, with high levels of public acceptance.

SUCCESS FACTORS

The Vision Zero policy can be seen as a radically new policy, starting from an ethical rather than from a cost–benefit perspective and introducing a new “system engineering” paradigm which leads to a host of innovations of various kinds. What is more, the policy is radical in its explicit and ambitious mission: zero deaths. This well-defined mission not only guides innovation efforts in a clear direction, but also allows – at least at the general level – for a straightforward evaluation of the effectiveness of policy by measuring the number of fatal accidents every year.



Source: Transport Analysis and Swedish Transport Agency (2021).

Figure 15.2 Traffic fatalities in Sweden

As is clear from Figure 15.2, the number of fatal accidents has indeed gone down remarkably. While other countries have managed to bring down the number of traffic deaths as well over this period, Sweden is ranked among the top countries in the world in terms of traffic safety (Mendoza et al., 2017). Recent data for 2020 show that the country experienced the lowest number of traffic deaths in Europe: Sweden lost 18 lives per million inhabitants against 42 lives per million inhabitants for the European Union on average (European

Commission, 2021). From a policy analysis point of view, then, one can ask why the Swedish Vision Zero policy has been such a success (Craens, 2019). Obviously, not all reduction in traffic deaths can be attributed to the Vision Zero policy, as exogenous factors (reduced alcohol consumption) and other policies (innovation from abroad) may also have contributed to the fall in fatalities.

Among the interviewees, the large majority indicated that the system design perspective was the most crucial success factor, referring to the design principle that traffic systems should be constructed in such a way that accidents never (or very unlikely) become fatal. Following this principle, many innovations were developed, tested, and implemented including the aforementioned 2 + 1 roads, roundabouts, and new speed limit system. What is more, Volvo and Saab intensified their safety innovation programs a few years after Vision Zero started.

The principle of system design was never implemented into legislation, meaning the policy was not binding for regional or local governments (Belin and Tillgren, 2013). This means that system designers and municipalities, in principle, could have resisted the Vision Zero principles. The system design was nevertheless widely followed, partly because it was supported by other policy tools, such as procurement for innovation, and by the government body Trafikverket. The main exceptions were some of the rural municipalities, covering areas where people typically drive long distances and value speed and low taxes rather highly at the expense of safety. In these areas, Vision Zero principles were not adopted to the full extent and they were free not to adopt them as Vision Zero principles were not codified into binding legislation (Craens, 2019).

A second aspect often mentioned as a success factor was the ethical approach underlying Vision Zero. The argument that any death in traffic is ethically unacceptable is both straightforward and hard to argue against. If one would disagree that any death is unacceptable, an immediate follow-up question is how many deaths one is willing to accept. Providing an exact positive number, then, is much harder than to argue that this number should be zero. This is even harder for a politician, who would have to argue that it is acceptable for a government to “kill” a particular number of people, while at the same time a government is expected to care about its citizens’ wellbeing. Another reason why the ethical basis is compelling relates to people’s personal experience. Most people have experience with traffic deaths or severe injuries in their personal sphere of family and friends. In all, the ethical basis of the policy is considered a key factor for politicians, experts, and the public in accepting the new policy. However, it must be noted that the ethical principles underlying Vision Zero are not uncontested (van Wee, 2011). In particular, as the policy continues, the marginal cost of preventing another traffic death is likely to

increase. Given the rising investment to reduce the number of traffic deaths, the policy may become “counterproductive” in terms of overall mortality as an alternative investment may save more lives (Elvik, 1999).

A third success factor relates to learning. Given the long-term goal and wide support for Vision Zero, learning can take place over long periods of time and be based on precise data. Policies went hand in hand with scientific research, meaning that most measures were only taken if scientific evidence was available, while scientific research projects were, in turn, motivated by questions related to traffic safety. The nation-wide adoption of Vision Zero and the innovation coming out of the policy also help in collecting systematic evidence from many sites and for different circumstances.

A fourth success factor is the cooperation between different types of actors. Through intensive cooperation, a wide range of stakeholders are activated to work within the Vision Zero policy. This allows different actors, each with their own expertise and legitimate scope for action, to contribute to the shared goal in a complementary and coordinated manner. Examples of these collaborations include those between the automotive industry and Trafikverket. Knowledge and information about the development of infrastructure and about fatalities is shared, in order to be taken up in the designs of new vehicles and infrastructures. As a result, the government policy and the innovation strategies of Volvo and Saab became increasingly aligned and complementary. Another successful cooperation is the speed camera project, with a consultancy mediating between private companies and Trafikverket. In addition, cooperation was sought with the police to set up a new approach to ticketing offenders. A final example is the establishment of platforms – such as the Group for National Cooperation for Roads – holding regular meetings between automotive firms, the police, ministries, municipalities, and regions.

Finally, some interviewees emphasized the ambition underlying the target of zero deaths. The ambitious nature of the target helped in achieving goals and going beyond actions that would normally be taken. The level of ambition not only motivates stakeholders involved to reach ever lower numbers of deaths, but also creates a continuous pressure from outside as politicians expect improved results year after year.

LESSONS FOR MISSION-ORIENTED INNOVATION POLICY

Vision Zero marked a paradigm shift in traffic safety policy by taking an ethical principle as the starting point and putting system design central. It can be considered a successful policy program as the long-term trend of traffic deaths in Sweden has been going down since, and Sweden currently has the lowest number of traffic deaths per capita across Europe. Obviously, a zero

number of deaths has not been achieved – and may never be achieved in the future – but the objective has remained and efforts are ongoing to get closer to this goal. The success of Vision Zero is further exemplified by similar programs being set up in different countries and cities worldwide. Although the exact policy process and implementation differs around the world, similar successes have been reported in bringing down traffic deaths.³

In the context of today's innovation policies oriented towards societal challenges, Vision Zero may serve as one example of how such an innovation policy can be conceived and implemented. In particular, Vision Zero can be understood as an instance of mission-oriented innovation policy *avant la lettre*. The mission character of the policy lies in the articulation of an ambitious and well-defined societal goal with broad support in politics and society at large (Larrue, 2021). Such bold objectives are now also being articulated in other domains, especially in the context of climate change (e.g., carbon neutral maritime transport in 2050) and healthcare (e.g., zero suicides). And, in its implementation, Vision Zero also resonates with the idea that mission-oriented innovation policy is about understanding innovation as “socio-technical”, involving technological, behavioral, and regulatory changes (Wanzenböck et al., 2020), and about a broad policy that coordinates several policy instruments, actors, and scales in a coherent manner (Larrue, 2021).

While mission-oriented innovation policy has quickly gained in popularity across governments, mostly in the Global North, there is not much consensus yet on how such policies should be designed (Larrue, 2021). Nevertheless, some possible “failures” have been formulated by policy scholars, failures that one needs to try to avoid in mission-oriented innovation policy (Weber and Rohrer, 2012; Wanzenböck and Frenken, 2020). We list these in Table 15.1 and provide an explanation of each. We can then use these possible failures that can be encountered in mission-oriented innovation policy as a way to evaluate Vision Zero.

If we look back at 25 years of Vision Zero policy through the lens of the four possible failures, we can conclude from our interviews that this policy has – indeed – been able to avoid most of the failures listed in the table. Handling these challenges has greatly contributed to the success of the policy. Regarding directionality failures, the policy did not only benefit from a clear articulation of a well-defined goal, but also profited from the wide support among different stakeholders. The underlying ethical principle that any deaths in traffic are seen as societally unacceptable greatly contributed here. To maintain focus and consistency in directionality, the delegation of policy coordination to a specialized agency with sustained funding helped. This agency identified strongly with the policy and actively promoted the vision among stakeholders. Demand articulation failures were also properly addressed in the Vision Zero policy. Before the introduction of the policy, both automotive manufacturers

Table 15.1 Four typical failures in mission-oriented innovation policy

Directionality failure	Lack of shared vision regarding the goal and direction of the transformation process; Inability of collective coordination of distributed agents involved in shaping systemic change; Insufficient regulation or standards to guide and consolidate the direction of change; Lack of targeted funding for research, development, and demonstration projects and infrastructures to establish acceptable development paths.
Demand articulation failure	Insufficient spaces for anticipating and learning about user needs to enable the uptake of innovations by users; Absence of orienting and stimulating signals from public demand; Lack of demand-articulating competencies.
Policy coordination failure	Lack of multi-level policy coordination across different systemic levels (e.g., regional–national–European) or between technological and sectoral systems; Lack of horizontal coordination between research, technology, and innovation policies on the one hand and sectoral policies (e.g., transport, energy, agriculture) on the other; Lack of vertical coordination between ministries and implementing agencies which leads to a deviation between strategic intentions and operational implementation of policies; No coherence between public policies and private sector institutions; No temporal coordination, resulting in mismatches related to the timing of interventions by different actors.
Reflexivity failure	Insufficient ability of the system to monitor and to involve actors in processes of self-governance; Lack of distributed reflexive arrangements to connect different discursive spheres and provide spaces for experimentation and learning; No adaptive policy portfolios to keep options open and deal with uncertainty.

Sources: Weber and Rohracher (2012), p. 1045; Wanzenböck and Frenken (2020), p. 54.

(like Volvo) and Trafikverket thought that there would be no market for road safety. With the introduction of Vision Zero, they learned this was not the case, as Trafikverket actively created and enhanced the market for traffic safety. They did this by using procurement tools and using the government as a lead example for taking safety measures. As a consequence, manufacturers introduced more safety features. Furthermore, Trafikverket actively informed end-users on how to behave more safely and use safer equipment in traffic. Another example of a measure to stimulate the market for safer vehicles was the Euro NCAP crash test program. The Swedish government, jointly with the national governments of the Netherlands and the United Kingdom, took a leading role in setting up this European program to test the safety of cars and enhance standards (Hobbs and McDonough, 1998). The resulting crash test scores helped in creating further awareness of safety among potential car buyers.

Dealing with policy coordination proved more challenging in the Vision Zero policy. On the one hand, a broad mix of measures to enhance traffic safety was introduced in a generally well-coordinated way. Policy coherence was also addressed as stakeholders were actively flagging policies in other domains that could – unintendedly – worsen traffic safety. More generally, mission-oriented innovation policy is built on both developing new policies to achieve the mission and abandoning existing policies that are counterproductive in reaching the mission. This is in line with the broader idea of transitions studies, that transformations also involve “phasing out” technologies and regulations (see Pel, Chapter 2 in this volume). Yet the Vision Zero policy also struggled with coordination. While a paradigm shift has taken place in the whole traffic safety sector, the legislation concerning traffic safety has not been adapted to the Vision Zero policy, leaving the concept of system designers without a legal framework. The lack of legislation created problems with regard to implementation. At regional levels especially, this causes problems, since regional authorities have their own responsibility in infrastructure planning. As some of the regions favor speed over safety, some roads still have a high rate of severe and fatal accidents. Trafikverket has few legal measures to increase safety on these roads. Furthermore, coordination between European and national levels of legislation proved difficult. Sweden and Norway are the only countries that have implemented Vision Zero in such a rigorous manner. The development of new national measures is sometimes hampered as implementation of safety regulation is coordinated among countries at the European level. There were also challenges in horizontal coordination between different policy domains. The focus on a single goal, which is common in mission-oriented innovation policy, can lead to trade-offs with other policy areas. While actors involved in Vision Zero acknowledge the importance of coordinating with people involved in other policy domains (sustainability, privacy, etc.), concrete actions in this regard are limited. This also limits potential spillovers between the development of technical innovations in these domains (Langeland et al., Chapter 7 in this volume).

Finally, potential reflexivity failures are well addressed in the Vision Zero policy. One of the main principles of Vision Zero is having a learning attitude. This principle is exemplified in the evidence-based nature of the policy. Proposed improvements are first tested and evaluated before implementation. Insights from industry about quality control and continuous improvement have been translated for the Vision Zero policy. There is an ongoing search for “best practice measures” that can be taken in order to save lives in the traffic system. Yearly follow-up data is retrieved for multiple traffic safety indicators and processed in statistical models so as to get insight into the current safety situation. Additionally, platforms which include stakeholders such as the vehicle

industry and non-governmental organizations (NGOs) have been established to discuss developments in traffic safety on a yearly basis.

The more general lessons that can be drawn from Vision Zero regarding mission-oriented innovation policy are threefold (Craens, 2019). For mission-oriented innovation policy to succeed, high-level political support is key. Given that, generally, missions cannot be completed in a few years, such a commitment needs to be rather independent from changing political coalitions in government cabinets, as these tend to change every few years. One way to ensure political commitment is to start from ethical principles that are both straightforward and widely shared. In transportation research, there is now a lively discussion about ethical principles such as equity and sufficiency, which could be drawn upon in developing new missions to address societal challenges related to transport (van Wee and Geurs, 2011; Verlinghieri and Schwanen, 2020). An example of such a mission would be: in 2050, everyone in the city should have access to all daily necessities within 15 minutes. As with Vision Zero, various types of innovations, such as new cycling infrastructure or Mobility as a Service (MaaS) technologies, could be combined to achieve the mission. A second way to ensure commitment to the mission-oriented innovation policy is to anchor parts of the policy in strict targets (such as the Paris agreement of CO₂ reduction in Europe) which can be translated into binding laws. Indeed, the Vision Zero case suggests that the policy could have been even more effective if principles were codified in legislation rather than being dependent on voluntary adoption by lower governmental levels. In the context of climate change, missions can be developed that combine a legal CO₂ reduction target with ethical principles such as equity. For example: all citizens should have access to affordable, zero-emission mobility in 2040.

A second key lesson that can be drawn from Vision Zero is the need to have the ability to measure progress along the way, and to attribute success and failure to particular measures. This allows stakeholders to evaluate progress on a regular basis as well as be adaptive in what policies and innovations to use. Collective learning is supported by a shared evidence base produced by an independent body. It should be noted that an evidence-based approach is highly established in transportation research and policy. Traffic measures are routinely evaluated by collecting large amounts of data on traffic participants. In policy fields such as transportation and healthcare, which have a longer tradition of evidence-based policy making, the learning component of mission-oriented innovation policy may be easier to implement. On the flipside, a challenge of current evidence-based approaches is measuring progress in terms of deeper-level institutional change (e.g., in terms of culture) (Pel, Chapter 2 in this volume). In addition, these types of changes can be important for achieving missions. A potential solution might be a more open strategy of evaluation which is sensitive to different types of impacts (includ-

ing social impacts) and unintended effects. For example, early electric vehicle users joined online communities, which then influenced the development of new driving and charging habits (Meelen et al., 2019). For mission-oriented innovation policies, learnings about such unexpected effects could be applied in subsequent rounds of innovation experiments.

Finally, in terms of impacts, while mission-oriented innovation policy is motivated by societal challenges, it may also contribute to more classic economic objectives of innovation policy such as job creation or economic competitiveness. By actively sharing the vision with a broad range of actors, including industry, new products can be developed and new markets can be created. In this respect, governments can use public procurement for innovation, promote standard-setting, introduce clear regulations, and support university–industry collaboration to help make local firms more innovative. An ambitious policy at national or regional level can thus create a “testbed” for all kinds of innovations that may later on be exported in global markets. A recent example of this is the Norwegian strategy for reduced shipping emissions, which went hand in hand with the development of local industrial capabilities to produce electric ferries (Bugge et al., 2021). Yet economic objectives should not be considered a key objective of mission-oriented innovation policy, as the primary goal of mission-oriented innovation policy is to tackle a persistent societal problem which traditional policies have failed to solve.

NOTES

1. Koen Frenken benefitted from financial support from the INTRANSIT center funded by the Norwegian Research Council.
2. For further details, see Craens (2019).
3. The success of the Vision Zero policy has not remained unnoticed outside Sweden, and several governments have adopted similar policies including Norway, provinces in Australia, several large cities in the United States, and London (Craens, 2019). Moreover, in Sweden the Vision Zero style of policy has been developed in sectors other than traffic safety. In particular, challenging issues like fire prevention, suicide prevention, and patient safety in hospitals have been subjected to the Vision Zero approach.

REFERENCES

- Belin, M.Å., and Tillgren, P. (2013). Vision Zero. How a policy innovation is dashed by interest conflicts, but may prevail in the end. *Scandinavian Journal of Public Administration*, 16(3), 83–102.
- Belin, M.Å., Tillgren, P., and Vedung, E. (2010). Theory and practice in Sweden: A case study of setting quantified road safety targets. *Journal of Health Medical Information*, 1(1), 1000101.

- Belin, M.Å., Tillgren, P., and Vedung, E. (2012). Vision Zero – a road safety policy innovation. *International Journal of Injury Control and Safety Promotion*, 19(2), 171–179.
- Bugge, M.M., Andersen, A.D., and Steen, M. (2021). The role of regional innovation systems in mission-oriented innovation policy: Exploring the problem-solution space in electrification of maritime transport. *European Planning Studies*, <https://doi.org/10.1080/09654313.2021.1988907>.
- Coenen, L., Campbell, S., and Wiseman, J. (2018). Regional innovation systems and transformative dynamics: Transitions in coal regions in Australia and Germany, in: Isaksen, A., Martin, R., and Trippel, M. (eds.), *New Avenues for Regional Innovation Systems: Theoretical Advances, Empirical Cases and Policy Lessons* (Berlin: Springer), pp. 199–217.
- Craens, J. (2019). Mission-oriented innovation policy and societal challenges: Lessons from the Swedish Vision Zero program. MSc Thesis “Innovation Sciences”, Utrecht University.
- Elvik, R. (1999). Can injury prevention efforts go too far? Reflections on some possible implications of Vision Zero for road accident fatalities. *Accident Analysis and Prevention*, 31(3), 265–286.
- European Commission (2021). Road safety: 4,000 fewer people lost their lives on EU roads in 2020 as death rate falls to all-time low, https://ec.europa.eu/commission/presscorner/detail/en/ip_21_1767.
- Fahlquist, J.N. (2006). Responsibility ascriptions and Vision Zero. *Accident Analysis and Prevention*, 38(6), 1113–1118.
- Hekkert, M.P., Janssen, M., Wesseling, J.H., and Negro, S. (2020). Mission-oriented innovation systems. *Environmental Innovation and Societal Transmissions*, 34, 76–79.
- Hobbs, C.A., and McDonough, P.J. (1998). Development of the European New Car Assessment Program (EURO NCAP). Transport Research Laboratory, United Kingdom, Paper Number 98-S11-O-06, <https://cdn.euroncap.com/media/1387/development-of-euro-ncap-1998-0-7498ffa2-36b6-4328-8b6e-f44fe5d35563.pdf>.
- Johansson, R. (2009). Vision Zero – implementing a policy for traffic safety. *Safety Science*, 47(6), 826–831.
- Larrue, P. (2021). The design and implementation of mission-oriented innovation policies: A new systemic policy approach to address societal challenges. OECD Science, Technology and Industry Policy Papers, No. 100, OECD Publishing, Paris, <https://doi.org/10.1787/3f6c76a4-en>.
- Lindberg, H., and Håkansson, M. (2017). *Vision Zero 20 Years*. http://www.afconsult.com/contentassets/8f0c19f4f7d24aa5bdbfd338128391ec/2017057-17_0194-rapport-nollvision-eng_lr.pdf.
- Mazzucato, M. (2018). Mission-oriented innovation policies: Challenges and opportunities. *Industrial and Corporate Change*, 27(5), 803–815.
- Meelen, T., Truffer, B., and Schwanen, T. (2019). Virtual user communities contributing to upscaling innovations in transitions: The case of electric vehicles. *Environmental Innovation and Societal Transitions*, 31, 96–109.
- Mendoza, A.E., Wybourn, C.A., Mendoza, M.A., Cruz, M.J., Juillard, C.J., and Dicker, R.A. (2017). The worldwide approach to Vision Zero: Implementing road safety strategies to eliminate traffic-related fatalities. *Current Trauma Reports*, 3(2), 104–110.

- Ministry of Transport and Communications (1997). En route to a society with safe road traffic. Selected extract from Memorandum prepared by the Swedish Ministry of Transport and Communications. Memorandum, DS.
- Rosencrantz, H., Edvardsson, K., and Hansson, S.O. (2007). Vision Zero – is it irrational? *Transportation Research Part A: Policy and Practice*, 41(6), 559–567.
- Schot, J., and Steinmueller, W.E. (2018). Three frames for innovation policy: R&D, systems of innovation and transformative change. *Research Policy*, 47(9), 1554–1567.
- Skvattram (2007). 2+1 road with cable barrier on Road 34 near Linköping, Sweden [Photograph]. Wikimedia Commons. https://en.wikipedia.org/wiki/2%2B1_road#/media/File:MMLNorr1.JPG.
- Thompson, D.F. (1980). Moral responsibility of public officials: The problem of many hands. *American Political Science Review*, 74(4), 905–916.
- Tingvall, C., and Haworth, N. (1999). Vision Zero – an ethical approach to safety and mobility. In *Sixth ITE International Conference Road Safety and Traffic Enforcement: Beyond 2000*, Melbourne, 6–7 September 1999. <https://eprints.qut.edu.au/134991/>.
- Transport Analysis and Swedish Transport Agency (2021). Road traffic injuries. <https://www.trafa.se/en/road-traffic/road-traffic-injuries/>.
- Van Staveren, M.F., Warner, J.F., van Tatenhove, J.P.M., and Wester, P. (2014). Let's bring in the floods: De-poldering in the Netherlands as a strategy for long-term delta survival? *Water International*, 39(5), 686–700.
- Van Wee, B. (2011). *Transport and Ethics: Ethics and the Evaluation of Transport Policies and Projects* (Cheltenham, UK and Northampton, MA, USA: Edward Elgar Publishing).
- Van Wee, B., and Geurs, K. (2011). Discussing equity and social exclusion in accessibility evaluations. *European Journal of Transport and Infrastructure Research*, 11(4), 350–367.
- Verlinghieri, E., and Schwanen, T. (2020). Transport and mobility justice: Evolving discussions. *Journal of Transport Geography*, 87, 102798.
- Wanzenböck, I., and Frenken, K. (2020). The subsidiarity principle in innovation policy for societal challenges. *Global Transitions*, 2, 51–59.
- Wanzenböck, I., Wesseling, J.H., Frenken, K., Hekkert, M.P., and Weber, K.M. (2020). A framework for mission-oriented innovation policy: Alternative pathways through the problem–solution space. *Science and Public Policy*, 47(4), 474–489.
- Weber, K.M., and Rohrachner, H. (2012). Legitimizing research, technology and innovation policies for transformative change: Combining insights from innovation systems and multi-level perspective in a comprehensive “failures” framework. *Research Policy*, 41(6), 1037–1047.