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Dynamic Adaptive Policymaking for the Sustainable City

The Case of Autonomous Taxis

Walker, Warren; Marchau, Vincent

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Dynamic Adaptive Policymaking for the Sustainable City:

The Case of Autonomous Taxis

V. Marchau (RU) and W. Walker(TUD)
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Radboud University Nijmegen

Overview

- **Urban transport problems and a (potential) solution**

- **What are adaptive policies?**

- **An illustration of an adaptive policy: Implementation of 'autonomous taxis' (ATs)**

Urban Transport Problems and a (Potential) Solution

- **Problems:**
  - **Growing externalities of road traffic (congestion, fatalities, consumption of scarce space, use of energy, emissions)**
  - **Inefficient use of user-owned vehicles; driver error (human error is the cause of over 90% of all vehicle crashes)**
- **Potential solution:**
  - **Self-driving vehicles combined with real-time ridesharing**
  - **Using autonomous vehicle technology, GPS to guide the vehicle, and smartphones for travelers to request and pay for rides**
  - **i.e. 'autonomous taxis' (AT)**

Benefits of ATs

- **Economic benefits:**
  - reduction in traffic accidents
  - reduction in traffic congestion
  - savings in parking costs and land use
- **Environmental benefits:**
  - reductions in emissions and fuel consumption
- **Social benefits:**
  - travel time reductions
  - savings in the cost of vehicles, fuel, insurance, and parking (land use)
  - more comfortable and more convenient traveling
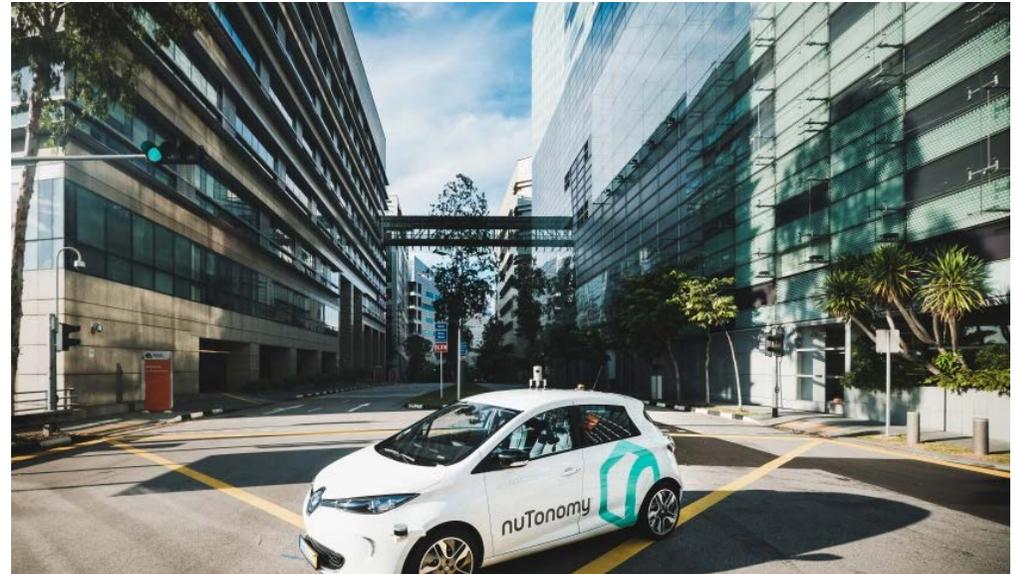
Self-Driving Taxis Hit the Streets of Singapore (Fortune, August 25, 2016)
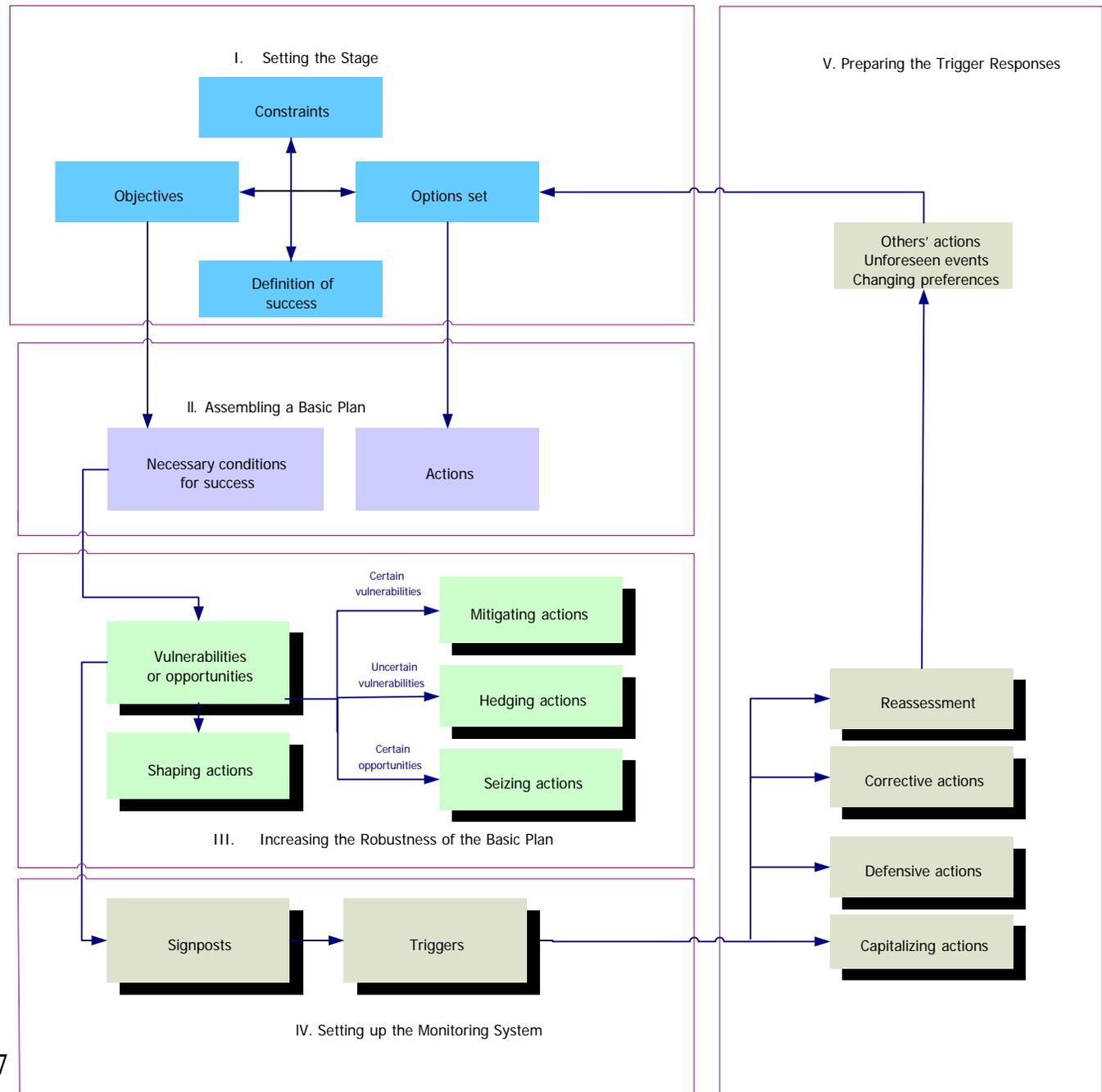
Status of AT-Implementation

- **Transport policymakers, automakers, shared driving organizations increasingly interested in ATs**

- **AT implementation delayed by a variety of 'deep uncertainties' (e.g. technological performance, public acceptance, legal regulations)**

- **Current policymaking:**
  - **'wait and see' attitude**
  - **let AT-implementation be determined by market forces**
  - **this could slow down the development of ATs and fail to advance general transport policy goals**

- **Need for AT-policy course to cope with these uncertainties and get implementation underway**

A New Policymaking Paradigm: Adaptive Policies

- **In this unpredictable, rapidly changing world, it is almost impossible to identify static robust policies**
  - Key assumptions underlying a policy may fail to occur
  - Opportunities may arise that should be seized upon

- **Over time, we gain information that resolves current scenario uncertainties**
  - Industry trends
  - Political and economic developments
  - New technologies

- **In fact, the only way to reduce these uncertainties is to learn by monitoring the system over time**

- **Thus, the best policies will be adaptive**
  - Take those actions now that cannot be deferred (or have 'no regret')
  - Prepare to take actions that may become beneficial
  - Monitor changes in the world, and take actions when needed

Designing an Adaptive Plan

[Based on W.E. Walker, S.A. Rahman, J. Cave (2001). "Adaptive policies, policy analysis, and policymaking", *European Journal of Operational Research* 128 : 282-289]

I.   Setting the Stage

Constraints

Objectives

Options set

Definition of success

II. Assembling a Basic Plan

Necessary conditions for success

Actions

III.   Increasing the Robustness of the Basic Plan

Vulnerabilities or opportunities

Shaping actions

Certain vulnerabilities

Mitigating actions

Uncertain vulnerabilities

Hedging actions

Certain opportunities

Seizing actions

IV. Setting up the Monitoring System

Signposts

Triggers

V. Preparing the Trigger Responses

Others' actions
Unforeseen events
Changing preferences

Reassessment

Corrective actions

Defensive actions

Capitalizing actions

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Handling AT-Uncertainties: The Adaptive Approach

I.   **Set the stage (objectives, options, constraints)**

II.   **Assemble a basic policy and conditions for success**

III. **Increase the robustness of the basic policy**

IV. **Set up a monitoring system**

V.   **Prepare trigger responses**

Step I: Setting the Stage

Identify objectives, available policy options, constraints, conditions for success

- **Objectives: make better use of scarce space, reduce congestion improve road traffic safety, improve the environment**
- **Urban transport policy options**
  - **Traditional measures: parking policies, improve public transport, urban road traffic management, spatial policies, etc.**
  - **Innovative measures: active driver support measures, car sharing (such as ATs)**
- **Constraints: costs, public acceptance, safety, etc.**
- **Definition of success: specification of desirable outcomes (specific levels of policy outcomes related to the objectives)**

Step II: Assembling a Basic AT-Policy

- **Specify a promising basic AT-policy**
  - Implement an Uber-like system in the city
  - With 'conditional' automated vehicles (driving task automated, but human (taxi-)driver would respond if requested to resume control)

- **Identify conditions for the success of the basic AT-policy:**
  1. support by regional/national government and other stakeholders
  2. acceptance by taxi drivers, operators, and travelers
  3. demand for taxis develops as originally forecast
  4. travel supply by other modes develops as originally forecast
  5. AT technology performs well
  6. ATs perform well in relation to general urban transport goals

Steps III and IV: Identifying Vulnerabilities of Basic Policy, and Adaptive Responses

- **Vulnerability (uncertain): Travel demand for ATs decreases**
  - **(H) Develop plans to expand the AT services to e.g. underserved specific groups/travelers within the urban region and/or to a larger region**
  - **Specify/monitor lower threshold for travel demand, to trigger expansion plan implementation**

- **Opportunity (uncertain): Travel demand for ATs increases**
  - **(SZ) Develop plans for expanding the AT-fleet above those planned for in the basic plan**
  - **Specify/monitor higher threshold for travel demand, to trigger AT-fleet expansion**

- **Vulnerability (certain): Opposition by taxi drivers, operators, and travelers**
  - **(M) Educate taxi drivers on the benefits of automated driving; subsidize AT-fleet development for the operators; provide campaigns and demos on the benefits of AT-use; assure travelers on the privacy of their information**
  - **Specify monitor for opposition per group and prepare education campaigns, privacy protection improvements, job training (for displaced taxi drivers)**

- **Vulnerability (uncertain): Technology failure**
  - **(H) Provide insurance in case of large failure; Establish an AT Safety Board**
  - **Specify/monitor for technology failures to trigger AT Safety Board investigations**

Step V: Implementing the AT- Policy

- **Basic AT-policy, vulnerabilities, and adaptive responses are agreed upon**

- **Basic policy is implemented**

- **Events unfold and signpost information is collected**

- **When a trigger event occurs, adapt the basic policy**
  - **If original objectives/constraints remain in place, take defensive/corrective actions**
    - **Expand AT-fleet in case of too high taxi demand**
    - **Upgrade AT-fleet to full automation in case of technological breakthrough**
    - **Make AT mode part of other upcoming transport modes (e.g. MaaS)**

  - **If event causes re-thinking of objectives/constraints, perform reassessment**
    - **E.g., malfunctioning technology resulted in large accident**
    - **Reassess entire policy; new policy learns from previous experiences**

Conclusions

- **Paradox of policymaking with respect to AT**
  - Great potential to contribute to urban transport policy goals
  - Paralysis in implementation due to large uncertainties related to AT outcomes, their valuation, and other developments

- **Challenge: To develop innovative approaches for moving forward while handling these uncertainties**

- **Adaptive policies**
  - Get implementation under way
  - Allow adaptations of policy over time as knowledge about AT proceeds and critical events in AT implementation take place, values change, and other external events take place
  - Enable learning from experience over time

Thank You

- **Vincent Marchau (v.marchau@fm.ru.nl)**
- **Warren Walker (w.e.walker@tudelft.nl)**