Dynamic Adaptive Policymaking for the Sustainable City
The Case of Autonomous Taxis

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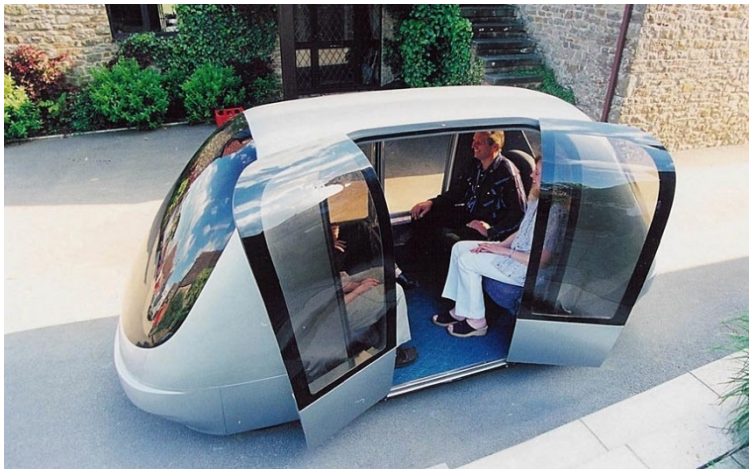
Dynamic Adaptive Policymaking for the Sustainable City:

The Case of Autonomous Taxis



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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**

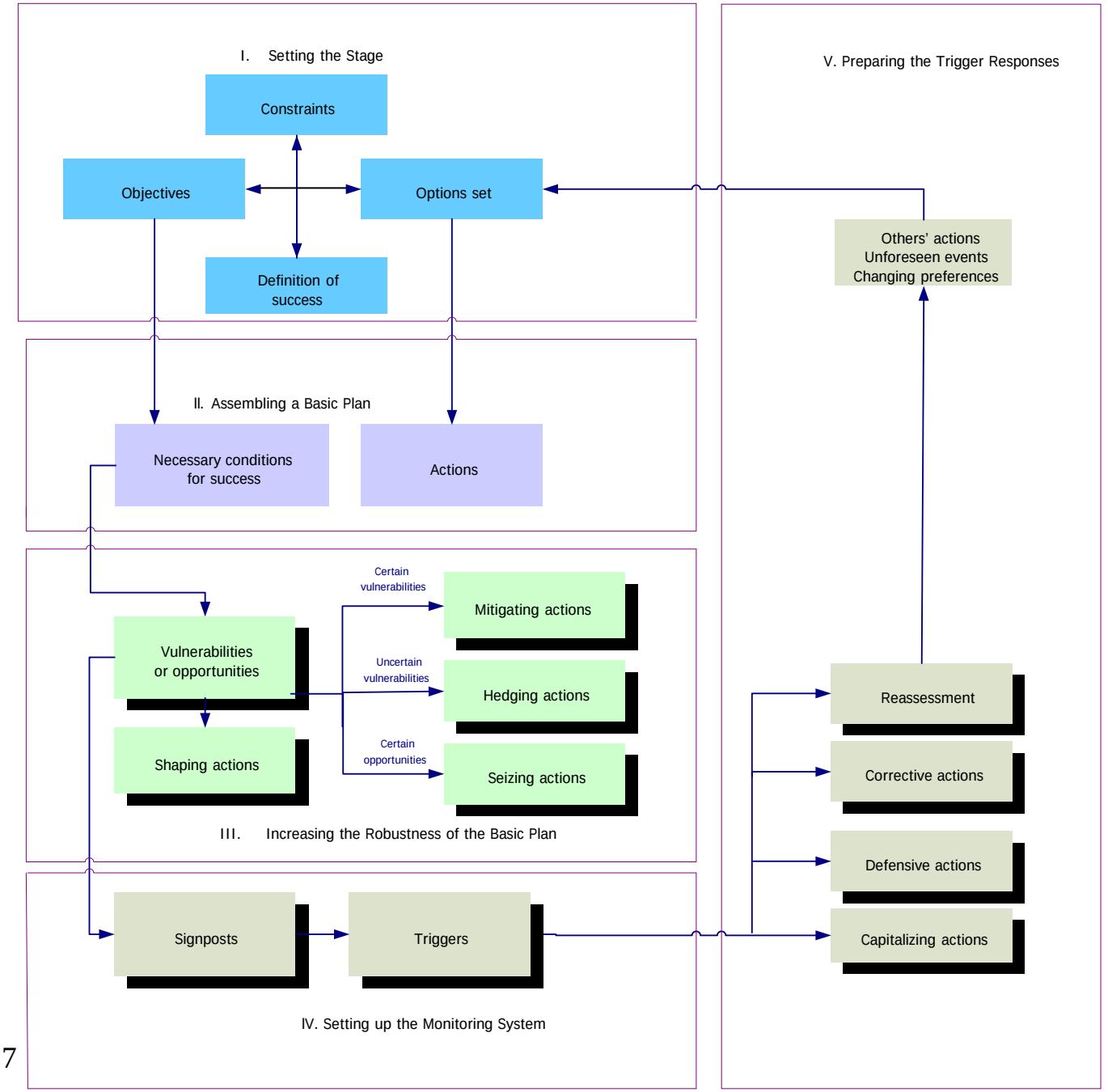
- **Over time, we gain information that resolves current scenario uncertainties**
  - **Industry trends**
  - **Political and economic developments**
  - **New technologies**

- **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]



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

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