# Modelling company actions

## or the efficiency of environmental policy measures

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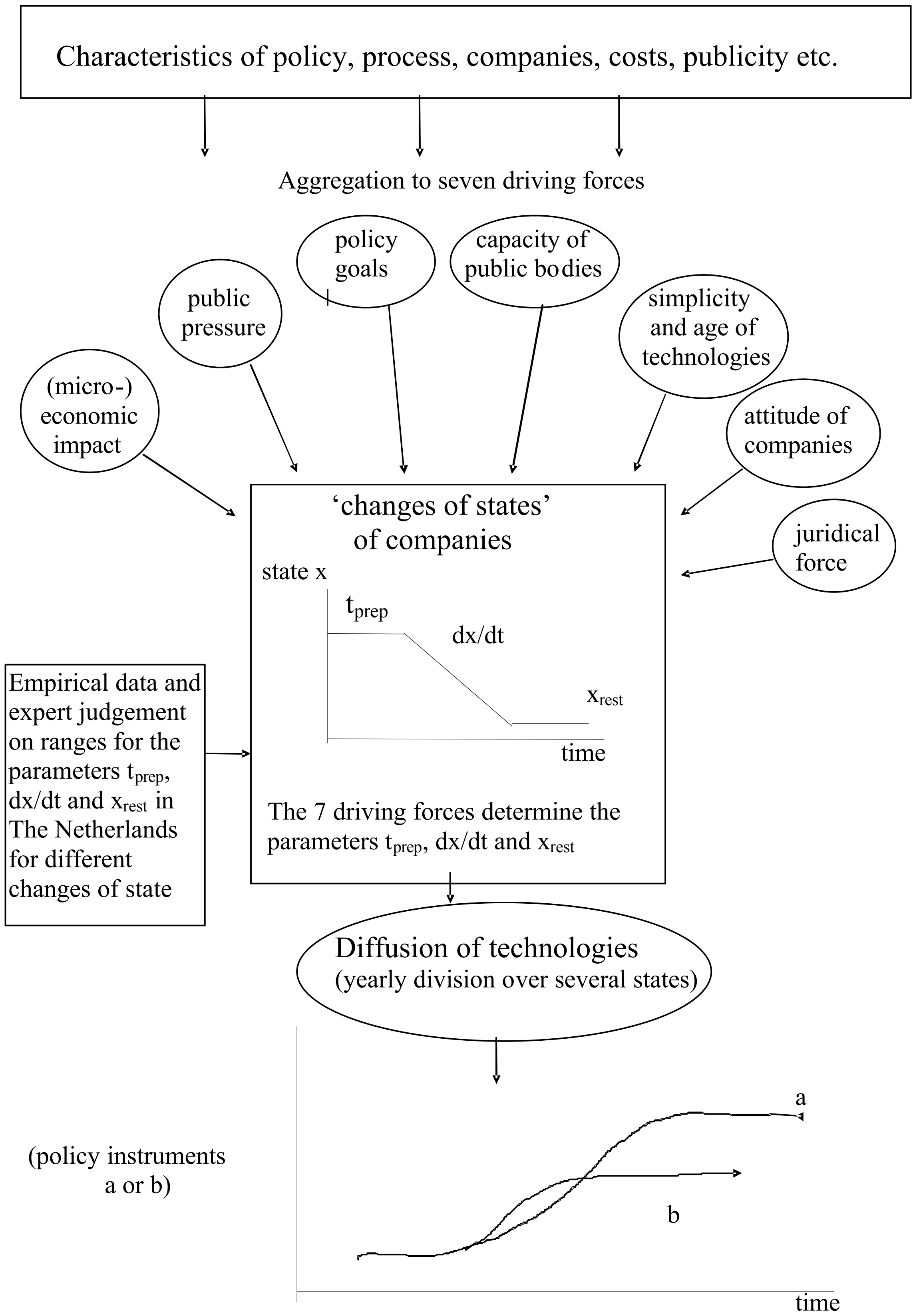
## Introduction

Behaviour of people is a the result of a complex process of exchange of information in different forms, risk assessment in many ways (especially personal), social and cultural background and individual characteristics. Complex and therefore hard to understand, even harder to predict. Behaviour of actors in companies related to environmental problems might be a little bit less complex, it's still a big challenge to get to understand to processes. In recent years many case studies have been done, specific information is analysed and more and less important factors are distinguished. To be able to make use of these insights a first attempt has been made to develop a structure for analysing these processes. After some experience with simple versions of such a structure a computer model has been built. The model is meant to be an 'expert supporting system'. It supports the expert in translating his (mostly qualitative) knowledge about a case into a prognosis of the implementation path of a technology or a package of measures.

## Elucidation of the model structure and purpose

A model can be considered as a structuring method to put all pieces of a complex puzzle together. The result is not a perfect picture, but it is an identifiable picture, even though some parts are still missing. Information from case studies is part of this puzzle. The more cases are studied, the more pieces of information are available. Then, the information is there. We know the pieces fit together somehow, but the extra value of using this information for policy decisions in new cases has not yet been made operational. The building of a model is an attempt to put the pieces together to gain this extra value.
For the complex field of diffusion of technology and the efficiency in environmental terms of policy instruments a first version of such a model has been developed. The basic idea of the model structure allows an analysis of cases in the past, but also an attempt for prognosis. The model structure offers a first survey of factors of success and failure and a method to combine them. It should be applied on a sector level (and not for individual companies). In figure 1 a simplified scheme of the model is presented.

Figure 1. Basic model structure for calculations of efficiency of environmental policy instruments (expert supporting system)



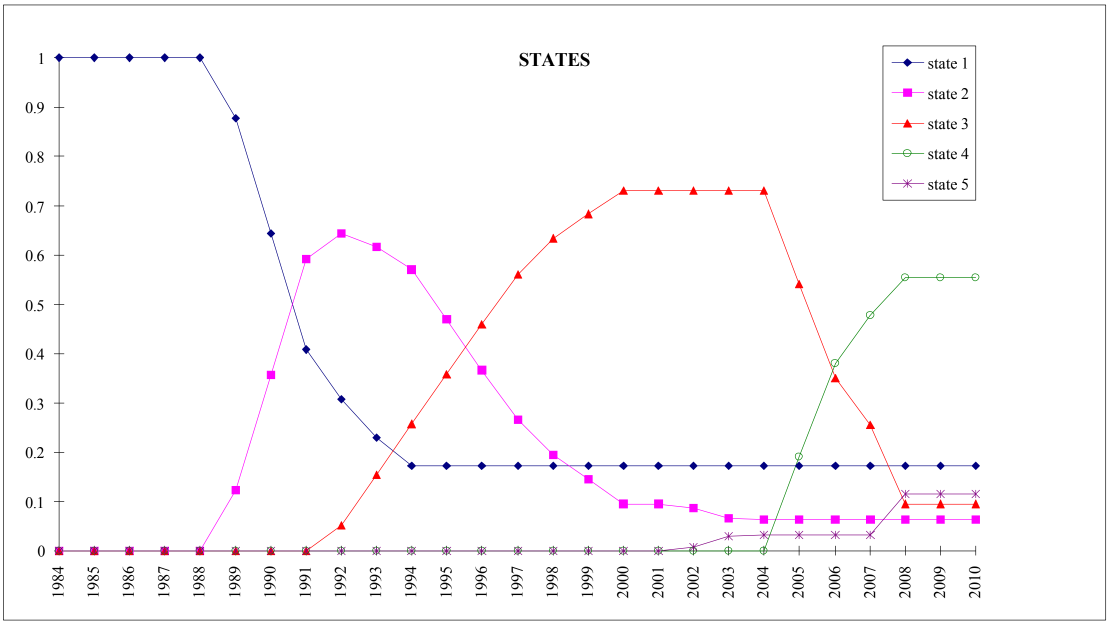
It is based on the idea that companies are in different states, mainly different technical situations. The environmental pressure (emissions) of a group of companies, a sector, is dependent on the distribution over different states, because every state has a characteristic emission factor. This distribution changes yearly under the influence of several driving forces (see figure 1). For every change of state a function with three parameters is used: the preparation time of the change of state, the speed and the part of the sector that will never change state.
These parameters are a function of seven driving forces. On their turn these driving forces are functions of characteristics of the environmental policy like guidelines, policy goals, subsidies, priorities etc., of the sector like their organisations, their knowledge of new technologies, the age of present installations, their economic situation etc., of the measures like the costs, the efficiency, the complexity, technical depreciation time etc. and of public attention, like signals from research, articles in the daily papers, actions of environmental groups. These are the recognisable pieces of the puzzle.
Table 1 shows the characteristics, which are used in the model. Some input is quantitative (i.e. technical depreciation times and ages of the installations), but most of it has the form of yes/no or a qualitative expert judgement on a 5-point scale. With the help of mathematical formulae these characteristics are aggregated to the seven driving forces. Each is scored on a scale of 0-10.

Table 1. Qualitative case characteristics determining seven driving forces

| Driving force | Determining characteristics |
|---|---|
| Micro-economic impact | - Operational costs<br>- Pollution charges<br>- Investment barriers<br>- Subsidies on investments<br>- Market position change<br>- Exchange of emission rights |
| Policy goals | - standards<br>- guidelines<br>- definition as best practicable technology<br>- emission goals (general/specific) |
| Public pressure | - specific publicity<br>- perceptibility<br>- environmental of public health problem |
| Capacity of public bodies | - their priorities<br>- goals for public body actions |
| Simplicity of technology | - familiarity for the sector<br>- information exchange within the sector<br>- subsidies for demonstration plants |
| Attitude of companies | - level of organisation of the sector<br>- innovative power<br>- agreements with public bodies<br>- willingness in other cases |
| Juridical force | - jurisprudence on the case<br>- degree of difficulty for control |

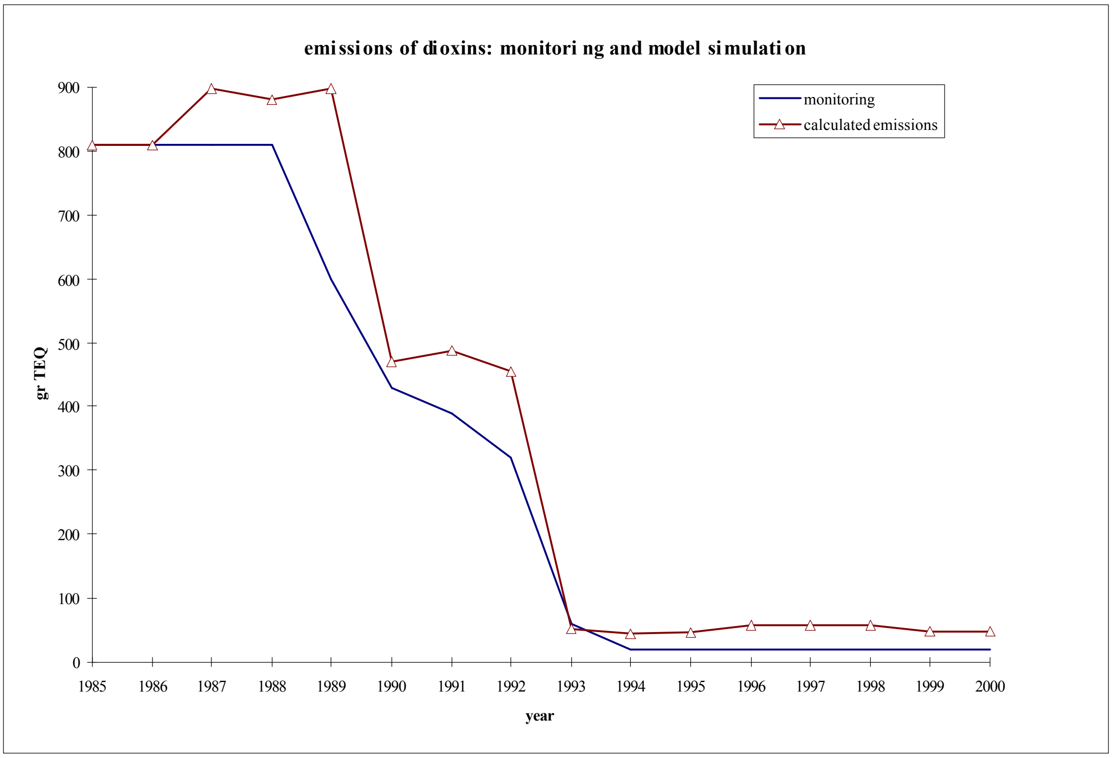
The driving forces are expected to stimulate changes of state of the companies. A change of state can be the implementation of a new technical system. With weighing matrices the contribution of the set of specific driving forces to the each parameter of each change of state is determined. The transposition of the rather abstract values of the driving forces into realistic values for the parameters is executed with the help of general empirical ranges for these parameters, which are broad because they count for all kinds of cases in the Netherlands.
For the companies five states are distinguished:
state 1: no specific measures in practice or in consideration
state 2: companies have specific permits
state 3: technology A is applied
state 4: technology B is applied as an extension of A
state 5: technology C is applied instead of A.
It is assumed technology B and C are options related to an accentuated policy goal compared to the policy aiming at technology A. Because the model calculates the driving forces yearly, policy changes in time can be included. Even the (later) introduction of new policy instruments aiming at the same policy goals can be simulated with the model.
Figure 2 shows an example of the model results in the form of the fractions of the companies in a certain state in time for a fictive case. The last step in the model is to combine these fractions with the emission factors, for which the user can also assume a extra ('autonomous') improvement in time, and with the development of the total production in the sector, for prognosis based on economic scenarios.

figure 2. Model in operation: Changes of state in time.




An example of the final output of the model is presented in figure 3. The case is dioxin emissions from waste incineration in The Netherlands. As explained before the input is expert judgement and therefore the output is expert related. In this example only the input of the authors of this paper has been used. The results are compared with monitoring data about the dioxin emissions.

figure 3. Example of model output.




The first version of the model, MEI 1.0 (Model for Efficiency of environmental policy Instruments) has been made in EXCEL 5.0. For information contact the authors.