Sense4Us Case Study

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This is a summary of a prototype project done at the University of Stockholm in 2015 for measuring the impact of changing policy. The paper can be found **here**.

Intro

The goal was to build a prototype for a policy-oriented modelling and simulation tool. More specifically, the tool should include a web UI with intuitive graphical representations that allows a user to model a public policy problem. Impact assessment can be thought of as a causal analysis problem. A variable X is changed, and this has an effect on another variable Y that is related to it. For example, decreasing an age requirement for a benefit eligibility (X) may result in more money being spent on the program (Y) in question. Various tools exist for processing causal data, but the authors found that there isn't much that exists specifically for public policy analysis.

Actors and Variables

There are some key steps that need to be taken when modelling a policy problem. You need to identify the issue that is driving a potential change, establish the objectives, identify key players, and assess both direct and indirect impacts of the change. Two important concepts to consider when creating a model are the "actors" and the "variables".

Actors refer to agents in the decision-making process. Depending on the policy in question, it could refer to the political organizations, committees, businesses, or individuals.

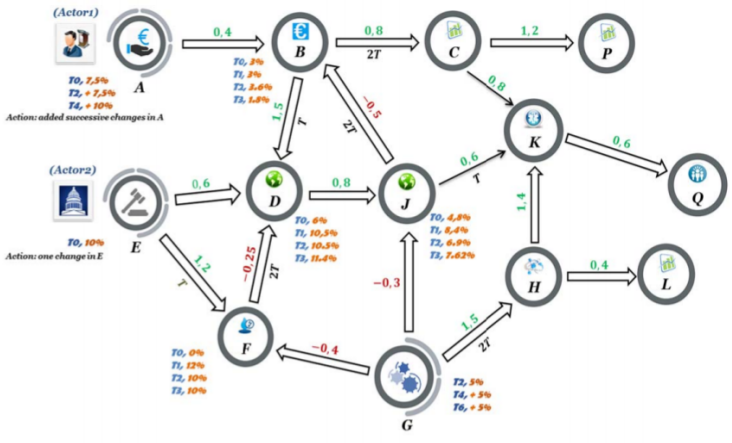
Variables are the pieces of data that we are interested in. This is a broad scope, so we can classify it into independent and dependent variables. Independent

variables are the variables that will change, and the dependent variables are those impacted by the change. We can further divide the independent variables into those that we can control and those that we can't control. Examples of data we can control include public expenditures, tax rates, property rights, enforcement of regulations. Examples of things we cannot control include environmental data, political ideology, and population growth. The independent variables represent the consequences of change in independent variables. This could include retail sales, government deficit, pollution levels, and poverty levels.

The Model

The idea behind the model is that "actors" have quantifiable goals related to the independent variables, and they are able to control certain dependent variables. Their goal state is the collection of these variables and their desired values. Actors are able to affect the independent variables, and these will have some impact on the dependent variables. This is almost like a formalized way of saying that people will act in a way to maximize their utility. It just posits that the goal state is a collection of quantifiable variables, and the actions they take involve changing quantities of other quantifiable variables.

Thinking of it this way, we are able to build a graph to show the relationships between different variables (image taken from source paper):



Each node represents a variable, and an arrow represents a relationship between two variables. If variable A points to variable B, then a change in A will cause a change in B. So nodes with no incoming arrows are origin nodes and some could be considered as key independent variables. Other variables are middle nodes, which have both incoming and outgoing arrows. Finally, we have the end nodes, which only have incoming arrows. These may represent the end states associated with an actor's goal state.

Some important considerations when using this type of model for a simulation:

- Which variables are relevant and controllable by actors, and are there any constraints associated with the variables. Which variables are not subject to control
- What actions need to be taken by the actor to generate a desirable system state or block an undesirable system state
- What are the costs and benefits of these actions

Application to a PDE

The paper goes on to outline a concrete model-building process as it relates to their prototype. The prototype appears to no longer be operational, yet we can still grab some very valuable lessons from this. It presents us with a formalized way of thinking about a simulation engine as it relates to policy.

Once we've decided on a rule that we would like to target, we can identify the actors and variables. We can then break down the variables into the dependent and independent variables, and then further break them down into areas under the actor's control and those outside their control. Once that is established, we can construct a graph to show the relationship between the variables and represent the goal state of certain actors in the space. This formalize graph encourages us to think about the problem in a logical way, so it can then be integrated into a machine-consumable format.