Modeling crime control in the Netherlands: insights on process

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Abstract

This paper is about a group model building project at the Ministry of Justice in the Netherlands. The aim of the model is to gain insight into the combined effects of an increase in the case load and investments in different phases of criminal justice administration and contextual developments such as increased complexity of cases. A group of representatives from the police force, public prosecution, courts and sentence execution participated in constructing the model from January to August 2004. In this paper we report on reasons for starting the modeling effort and the process of model construction. We then compare the procedure followed to 'scripts' – small parts of modeling process that have been tested out in practice and serve as standard building blocks for a group model building project. Scripts specify a technique, the situations for which it is suited and the expected results, enabling a modeler to choose from the wide variety of available modeling techniques. By describing the process followed in this case and consistently relating it to well-established practices we hope to further clarify the modeling process, by contributing to the existing body of modeling techniques and the dissemination of process insights.

Aim and plan of the paper

The construction of system dynamics models in cooperation with problem owners or experts has been documented since the 1980s (Andersen et al., 2007). In a 1997 paper, Andersen et al. feel the involvement of clients in modeling is still the domain of gifted practitioners. In an attempt to synthesize and consistently describe modeling practices, Andersen and Richardson (1997) develop the concept of scripts. A script is a repeatable element of process that, if used in a specified context consistently yields similar outcomes. The total session is broken up into periods of 15 to 20 minutes each and the activity in each period is carefully planned. Andersen and Richardson list a set of guiding principles for session design as well as twenty different scripts grouped around five steps in modeling: defining a problem, conceptualizing model structure, eliciting feedback structure, equation writing and parameterization, and policy development. In later work (Cresswell et al., 2001; Richardson et al., 2004; Andersen et al., 2004; Zagonel, 2004; Luna-Reyes et al., 2006) additional scripts are described. In this paper we aim to contribute to the growing library of modeling scripts by describing a large modeling project in detail. The paper is structured as follows. We first describe the background of the central problem and criminal justice modeling effort. We describe the qualitative and quantitative phases of modeling construction. We then confront the process description with existing scripts and end by identifying a set of scripts that have so far not been explicitly described in the literature.

Problem context

The Dutch criminal justice system is probably best known for its mildness (Tak, 2003). The policy on drugs and low prison rate in the 1970s are known by both foreign scholars and the wider public. Since a few years, this tradition of mildness is challenged. Delayed implementation of prison sentences, in spite of large scale prison construction in the early 1980s and again in the 1990s, became an issue of growing public and political concern. A Safety Program for crime control was formulated by the Dutch cabinet in October 2002 (Ministry of Justice/ Ministry of the Interior and Kingdom Relations, 2002). The policy plan formulates four goals for Dutch safety policy for the period 2003 - 2006: 1. lowering the number of offenders who, after serving their sentence, reoffend, as well as more attention for juvenile offenders who are likely to start a criminal career; 2. lowering the number of crimes that do not lead to law enforcement interventions, 3. a more prominent presence of police in the public domain; 4. increased attention to prevention. In particular the low number of crimes that lead to interventions by law enforcement agencies is important here. The feeling that 'offenders can get away with it' obviously harms the interest of victims of crime and the credibility of law enforcement agencies (Tak, 2003: 14). The Safety Program estimates the number of crimes that do not lead to any intervention at about 80,000 cases. Since about half of these cases had a known suspect, the number of 40,000 cases quickly gained public status as the 'prosecution gap'. In order to prosecute and close more cases and achieve the other goals of the Safety Program, targets for all partners in the administration of criminal justice were formulated. Over the period 2003 - 2007, the police was expected to deliver 40,000 more cases to the public prosecution. The goal to increase the presence of police in the public domain was expected to lead to more cases as well. In this context 180,000 minor cases gained attention as the likely number of cases to follow from increased police presence. These cases consisted of police arrests for minor offences such as misbehavior in a public area and minor offences. To process the expected increase in case load, capacity for the different organizations in criminal justice administration was to be adjusted accordingly and the budgets of public prosecution, courts and sentence execution were to be increased. The coordination and monitoring of activities for the Safety Program was delegated to an interdepartmental Safety Taskforce.

There were significant uncertainties surrounding these attempts at controlling crime. The Safety Program did not specify with regard to which categories of cases the police is to increase its efforts. This inspired discussions in the media and gave rise to expectations that the police would try to achieve their target by booking only the least labor intensive offenses, such as traffic violations. However, data for 2003 seemed to indicate that the extra cases followed the general pattern and no specific category was overrepresented. Nevertheless, as the target of extra cases had not been completely realized at that point, no final conclusion could be reached with regard to the 'seriousness' of the extra cases and the associated workload for the other partners in administration of criminal justice. A second uncertainty is the distribution over time of increases in workload and capacity. While budgets are increased incrementally for several organizations that are responsible for criminal justice administration and the effect of budget increases takes time to materialize, the case output of police is

ahead of schedule. If workload and capacity are too far out of balance, processing time increases and this might conflict with legal requirements. Examples of these are the maximum duration of police custody or the maximum period before a judge needs to pass verdict. Thirdly, developments in Dutch society and the wider European context have a big and uncertain impact on criminal justice administration. An increase in the crime rate and the proportion of serious and organized crime (Tak, 2003: 9) lead to a higher case complexity. New regulations inspired by the European Union call for more attention for victims of crime, including extended possibilities for presence at trials and receiving regular information about trial proceedings. Finally, a large number of retirements for public prosecutors (district attorneys) and members of courts are foreseen in the coming years.

Aim of the modeling project

In order to achieve more insight into the combined effects of an increase in the number of cases, investments in capacity and environmental developments, the Safety Taskforce asked the Ministry of Justice to initiate the development of a system dynamics model. The choice of system dynamics as the approach to model this problem deserves closer consideration. The regular annual planning cycle of the Ministry of Justice is based on input from a number of econometric models, which have been developed to predict crime rates for different categories of offences and estimated need for detention capacity. Most of these econometric studies are carried out by the WODC (Scientific Research and Documentation Center), the research agency working on behalf of the Ministry. However, system dynamics has been chosen to study this problem as an important project deliverable was a transparent model of causal mechanisms and the effects of different scenarios. Policy makers needed an instrument that helped them to figure out the effects of the policies they have in mind. The resulting model should provide them with actionable and effective intervention points in administration of criminal justice. The central questions guiding the modeling effort were formulated as follows:

- What is the effect of a structural increase of 40,000 cases on the different parts of criminal justice administration?
- What is the effect of additional investments in capacity of organizations involved in criminal justice administration?

The project was named Simulatiemodel Strafrechtsketen (simulation model criminal justice chain) or SMS. In October 2003 the Ministry of Justice invited interested parties to send in a project proposal including a detailed planning for the SMS project.

Project group, participants and kickoff meeting

In this section we describe the project group, participants and process of modeling. At the Ministry of Justice two persons were involved fulltime as members of the project team. Three consultants from Significant, a consulting firm specializing in quantitative methods and techniques (i.e. system dynamics) and project management, contributed a total of about three days per week over the course

of the project. Two researchers from Radboud University Nijmegen were involved for about two days per week. A managing director from Significant and a professor from Radboud University Nijmegen were responsible for quality assurance. The project plan called for monthly progress reports and intermediate products, such as a report summarizing the qualitative models and several documented versions of the formal model.

After the project staffing and preliminary planning were agreed upon, the project team members from the Ministry of Justice selected eleven participants for the sessions. The participants were representatives of the main organizations in the administration of criminal justice: police, public prosecution, courts and sentence execution, probation services, WODC and different departments of the Ministry of Justice. We will refer to this group as the reference group, to distinguish it from the modeling team who constructed the models and facilitated sessions. The complex relation of the police force to the national Ministries made it difficult to involve participants from that field. Although one member of a police research organization participated in the project from the outset, a participant from the police force itself was present only from the second workshop onwards. Participants worked at senior levels in their respective organizations, and had intimate experience with their field and political decision making. This was evidenced by the fact that some of the participants were responsible for answering questions from Members of Parliament to the Minister of Justice. On the one hand, the seniority of participants created a desire to limit time investment as much as possible and ensure that interviews and sessions would be involving and result in new information. The participant group and setting (at the level of a national Ministry) introduced meeting conventions which were not part of 'standard' group model building practice but are common practice in the meetings to which participants were used. An example of this is the discussion of the previous meeting's notes.

Before starting interviews and modeling sessions, a kickoff meeting was held in December 2003 with participants, project team and project managers and commissioners from the Ministry of Justice. In the kickoff meeting the project organization was outlined and the members of the project team and managers introduced themselves. The rationale for using a simulation model and system dynamics was addressed and the central questions, the project goal and phasing were presented. The project was divided into four phases:
1. conceptualization (January - March): development of a conceptual model;
2. formalization (April - June): formalization of the model;
3. testing (July - August): testing and further validation of the model;
4. training (August): handover, further documentation of the model and user training.

The use of group model building was illustrated by presenting two cases: a qualitative group model building project on safety in a city neighborhood (the first case described by Rouwette, 2003), and a formal modeling project on price competition involving organizations of harbor docking pilots. Particular emphasis was put on the involvement of stakeholders and experts in constructing the model and resulting effects on insights for the participants.

Conceptualization phase

The conceptualization phase started with a round of interviews with all members of the reference group. The interviews took place in January 2004 and focused on four subjects: background of the extra 40,000 cases, expected effects of extra caseload on different parts of the criminal justice system, indicators for system performance and possible interventions to alleviate expected problems. The interviewees sketched the separate parts of the criminal justice administration, and described unintended effects of policies in one part of the system on organizations in other parts. Two diagrams of side effects, or so-called 'mechanisms', are important here as they were used as an input for the discussions in the first and second workshop. These mechanisms concern the early release of prisoners and general reactions to workload.
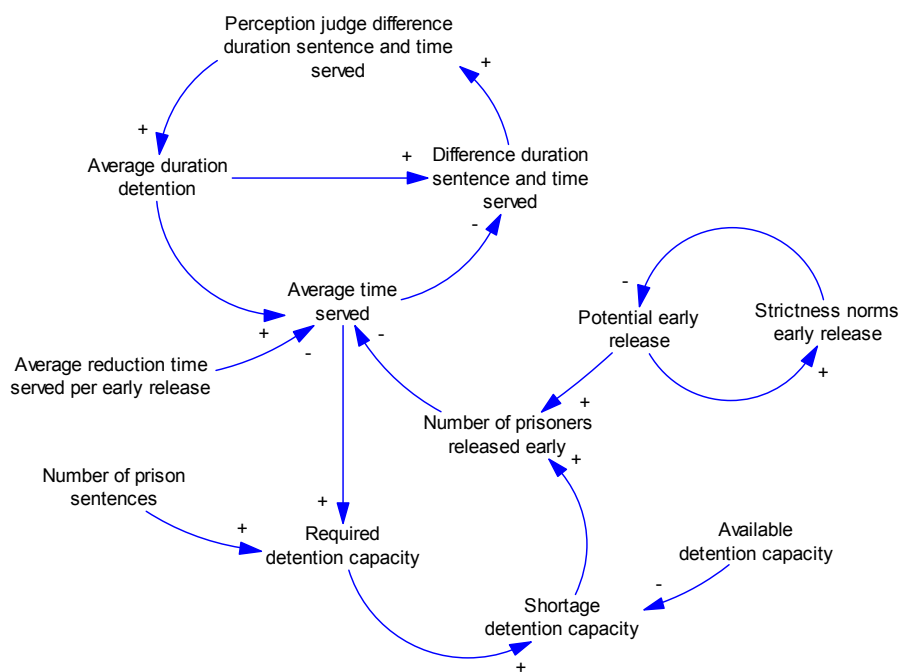

Figure 1. Example result from interviews: early release of prisoners

As described in the section on problem context, the Dutch Prison Administration had been faced with a shortage of prison capacity for years. The lower part of figure 1 shows required detention capacity, which can be calculated by multiplying the number of prison sentences with the average time served. If required detention capacity is greater than available detention capacity, a shortage of capacity results. In 2000, the Prison Administration initiated a policy that made prisoners who are serving time for infractions and have completed 90% of their sentence eligible for early release. In 2003 the strictness of norms for early release was reduced and prisoners who had completed 70% of their sentence were eligible for early release. This increases the potential number of early releases and actual releases: in 2000 a total of 200 prisoners were released early, rising to 446 in 2001 and 4,837

in 2002 (Algemeen Dagblad April 25, 2003; Annual report Prison Administration 2002). By reducing the average time served, the early release policy frees up capacity for new prisoners. However, in an interview one judge mentioned that he became aware of the policy after he recognized a suspect as someone recently convicted and imprisoned for an earlier crime. He then became concerned that the sentence passed for the earlier crime was not served to completion. He foresaw that when judges would perceive an increase in the difference between duration of the sentence and time served (upper part of figure 1) they would compensate by increasing the duration of sentences. The early releases balancing loop in the lower part of figure 1, and the sentence duration balancing loop in the upper part of figure 1, in combination create an escalation or relative control archetype (Wolstenholme, 2004). This example shows how feedback effects play out over different parts of the criminal justice system.

A second mechanism concerns the general reactions to an increase in workload. As can be seen in figure 2, the mechanism includes one stock of work in process and three possible reactions: an organization could cope with increased workload by increasing efficiency, increasing staff capacity or 'opening valves'.
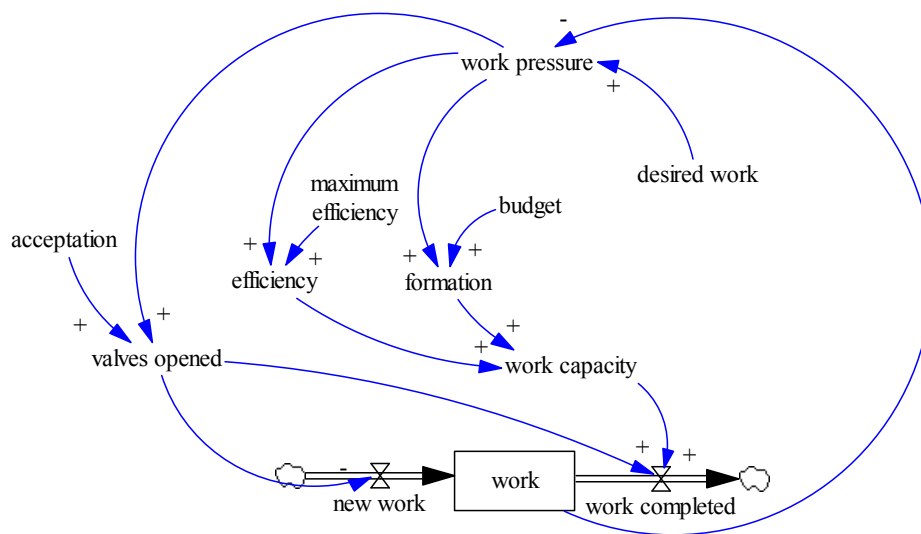

Figure 2. Example result from interviews: general reactions to workload

The term 'valves' was used by several interviewees and captured ways in which an organization tried to influence its inflow and outflow of cases. An important way of influencing the inflow was to accept less work from an organization upstream, for instance when the public prosecution refuses certain types of cases brought in by the police. Attempts to increase the outflow of work were also called 'alternate processing of cases'. An example of this would be when the public prosecution offers a transaction instead of bringing a case to court. Since this alternate way of processing a case costs less time per case, this saves on workload. Each of these three reactions to increased workload was bound to a maximum: maximum efficiency, the staffing budget and the degree to which opening valves (or using alternate ways to process work) was accepted by partner organizations and the general public.

The overview of the separate parts of the criminal justice system was summarized into two stock&flows diagrams. The diagrams were similar to workflow diagrams that were used in several parts of the criminal justice system. The first diagram showed what was called the 'paper flow' or case flow: case files passing from police to public prosecution and to courts, reverse flows (cases sent back, for example because files are incomplete) and the different outflows at intermediate or final stages when cases are dismissed or a sentence is passed. The second diagram showed the 'person flow': adults and youths going in or out different forms of detention or serving task penalties.

There was considerable overlap between interviewees' ideas on indicators for performance and possible interventions in the criminal justice chain. Indicators that were proposed include among others caseloads at different points in the chain, processing time, processing quality, delays and idle time in processing of cases, early releases, perceived safety (as indicated by annual safety surveys, police monitors and victim surveys), fraction of crimes put on trial and execution of sentences. Possible interventions were changes in the Code of Criminal Procedure, increasing alignment among organizations in the criminal justice chain, improvements in information exchange among organizations, agreeing on norms for case flows, increasing capacity for psychiatric care and care for addicts, increasing the capacity of organizations and increasing the number of early releases. It is clear that indicators are both at the level of workflows as well as perceptions by the general public. In addition, some factors are mentioned both as indicators and intervention points.

Interview results were summarized into a 38 page report. The report and diagrams were used as an aid in the modeling team discussions and modeling meetings. The next part of the conceptualization phase consisted of three workshops. The following table shows the timing, duration, topics and products of each workshop. The last column also indicates the number of pages for each document.

Workshop 1 Feb 4, 2004 4 hours	- Introduction project and team - Model boundary and results interviews - Discussion in two subgroups on factors influencing inflow, processing and outflow, reaction to workload and points of contact between organizations - Plenary conclusion	- Workbook 1. 4p introduction SD - Workbook 2. 20p report and questions
Workshop 2 Feb 19, 2004 4 hours	- Reactions workbook - Discussion in two subgroups on person flow - Plenary conclusion - Discussion in two subgroups on reactions to work pressure - Plenary conclusion	- Workbook 3. 49p report and questions
Workshop 3 March 4, 2004 3 hours	- Exogenous, endogenous, indicator variables and variables outside of model boundary - Discussion in two subgroups on diagrams submodels - Plenary conclusion - Close conceptualization phase and planning formalization phase	- Report conceptualization phase 83p

Table 1. Overview of workshops in the conceptualization phase

Since not all members of the reference group had attended the kickoff meeting, the first workshop started with a short introduction of the project team, the project goal and time schedule. The project goal was again defined as gaining insight into the effect of 40,000 extra cases and investments in capacity. A major goal of the first session was to discuss and align expectations on the project's outcome. To this end a short text on system dynamics modeling was sent out before the workshop and the model boundary was explicitly addressed in the meeting. Specifically, the participants were asked the following four questions. Which organizations should or should not be included in the model? Which level of detail will be aimed for in the model? Should a distinction be made between juveniles and adults? Should the model include both the flow of cases and persons?

An important factor placed outside the model boundary was crime. Although organizations in the criminal justice system strive to have an impact on future levels of crime, this effect was deemed too complex to include in the model: the level of crime would be modeled as an autonomous development and in terms of alternative scenarios. The interaction between the criminal justice system and levels of crime was to be included in a future extension of the model. The decision was made to include infractions (misdemeanors) as well as felonies in the model as both categories are processed by the public prosecution and courts. Cases would not be refined further by discerning categories of criminal acts similar to the Code of Criminal Procedure, since participants felt that variance with regard to case processing was often larger within categories than between categories. Categories of cases would only be distinguished if they led to differences with regard to the way cases were processed or workload for the organizations involved. As the difference between juvenile and adult (suspected) offenders was important in this regard, this distinction would be included in the model. With regard to organizations, the participants decided to include organizations to the degree that they influenced the flow of cases

and persons in the criminal justice system. The police force, public prosecution, courts and sentence execution would be central in the model. 'Satellite organizations' such as specialized forms of detention would form the model boundary, indicating that they would be included but not modeled in detail.

A second goal of the first session was to report and build on the results of the interviews. The feedback on the interviews consisted of a presentation of the stock&flows diagrams on the case and person flows, the indicators for performance of the criminal justice chain, the interventions proposed to improve performance of criminal justice administration and the examples of feedback mechanisms in the criminal justice chain. The list of indicators from the interviews prompted the participants to add further goals of the modeling project: in addition to answering the two central questions, the model should show how interventions have an impact on the system, create a feeling for the operation of the system, indicate strengths of relations between parts of the system, provide room for wild as well as educated guesses and show confidence intervals of estimations.

One hour and fifteen minutes of the first workshop was devoted to a discussion in subgroups. Participants working with the police and public prosecution were placed in one subgroup, and courts and sentence execution in the second subgroup. Both groups were asked to generate ideas on the following questions: which factors determine the inflow, processing and outflow in this part of the system? How does the generic mechanism of reacting to increases in workload operate within this part of the system? At which points do the different parts of the criminal justice chain meet? For the first question participants were provided with prints of the two stock&flows diagrams on A3 sheets of paper. Discussing this question for the case flow only, took up most of the time in the subgroups. The person flow and the questions on the reactions to workload and contact points were only briefly addressed. The subgroups presented their results in the plenary group in about half an hour. The workshop closed with a short announcement on the planning for the future workshops and workbooks in between sessions and a short evaluation. The workbook after the first session summarized the conclusions with regard to project focus and depicted all diagrams including a revised version of the case flow. It also included questions on the case flow, person flow and the diagram on reactions to workload. Participants were asked to list both decisions on workload arising within the organization as well as impacts originating from upstream or downstream organizations.

The second workshop opened with a discussion on the notes of the first meeting. The major part of the workshop was formed by two one hour discussions in subgroups, each followed by a 15 minutes plenary presentation. Similar subgroups were convened as in the first meeting: participants from police and public prosecution in one subgroup, courts and sentence execution in the other. The first subgroup meeting continued where the discussion in the first workshop had left off. Participants were presented with the stock&flows model of the person flow and asked for their comments. This discussion resulted in many detailed comments on how people flow into the criminal justice system,

how they flow from one form of detention to another and how they might flow out of the system. Several flows were driven by maximum times of residence. An example is the maximum detention time in a police cell (16 days) after which people will have to move on to other forms of detention or be released. Another important factor was capacity taken up due to lack of capacity downstream, for instance when people remain in remand custody because there is no room in prisons with specialized psychiatric care. Comments were noted on flipcharts but not directly added to the models. The second discussion focused on staffing and capacity for the four main organizations in the criminal justice chain. As an input to the discussion, participants were presented with a stock&flows diagram that was developed from the mechanism on general reactions to workload. Please recall that the initial mechanism included one stock of work in process and three possible reactions: increasing efficiency, increasing staff capacity or alternate processing of cases (prioritization). The diagram used in workshop 2 was more detailed in that it showed four stocks of work in process (work in process in upstream organization, work in process, work completed unchecked, work completed checked) and two stocks of staffing (staff in training and staff). Three more reactions to workload were added to the original three: an increase in the fraction of hours in direct production, quality improvements in the organization under consideration or in its partner organizations. Quality improvements were expected to influence work processing by reducing rework. Participants were asked to answer the following questions in their subgroup: does this diagram reflect processes in your own organization? Which factors would you like to change or add to the diagram? How do the six general reactions play out in your own organization? Does your organization have a preference for specific reactions? If so, what do these preferences depend on? Are there factors in your own or nearby organizations that influence, hinder or facilitate these reactions? The results of this discussion were summarized in a table, which specified for each of the four main organizations how priorities and valves, quality and efficiency and staffing and training influenced their work processes. Part of the result is shown in table 2.

	Priorities and valves	Quality and efficiency	Staffing and training
Police	- Policy norm: indicated prosecution policy - Pressure on capacity cells from lack of capacity downstream	- Extent of external consultation - Room for efficiency increase	- Agents in training can be used for executive tasks for 40% of their time - Training time
Public prosecution	- Dismissals due to quality of processing upstream - Lowering demands case so that single judge can handle case	- Management by maximum duration processing time - Extent of external consultation	- New budget for 2004 - Number of trainees following short program
Courts	- No valves - Maximum number of cases in particular categories	- Management by maximum duration processing time - Minimal size of courts due to training capacity	- New budget for 2004 - Sickness leave
Detention enforcement	- Early releases and lowering norms - Treatment of psychiatric patients	- More people in one cell - Market parties for detention	- Short training time - High drop out in training

Table 2. Example result of workshop 2

The second workshop ended with the planning of future meetings and products and a short evaluation. The workbook after this session included an updated version of the notes of the first session, the conclusions of both subgroup discussions in the form of bullet points, the table shown above and updated stock&flows models. The modeling team updated the stock&flows models on the basis of the subgroup input. Incorporating participants' comments in the models was straightforward in most cases, for instance adding available prison capacity as an influence on the number of people in remand custody. The main changes to the model of the person flow were the addition of maximum capacity for police prisons, remand custody, prisons, and prisons with psychiatric care ('TBS'), the separation of outflows of other detention forms (such as community service) into completed or failed sentences, and developing a separate stock&flows diagram for juvenile delinquents. Participants were asked to go over the diagrams and descriptions of each, and indicate what needed to be added or changed. A similar approach was used for the staffing and capacity diagram: the modeling team integrated comments into the diagram and participants were asked to check the diagram and description. The workbook included separate diagrams and descriptions for the case flow of police, public prosecution and courts, as well as capacity and formation for each. With regard to staffing and capacity for public prosecution and courts, the workbook included a set of questions on the assignment of capacity to different tasks. For instance, how does a district attorney prioritize among transgressions or felonies, and dismissals, transactions or summons? The general reaction to workload was now addressed on a more detailed level, for example by asking when a district attorney would decide not to bring a case to court but offer a transaction. Participants were also asked to indicate to which extent data would be available on these decisions, and where.

The main objective of the third workshop was to make a final review of the diagrams so far and check if these covered the relevant aspects of the problem. The session thus started with a presentation of variables that were considered endogenous to the model, exogenous variables, variables that would be used as indicators only (variables calculated by the model that have no effect on other model variables) and variables outside of the model boundary. Endogenous variables included the workflow of the police, public prosecution and courts and the person flow managed by sentence execution. Exogenous and indicator variables were the number of crimes and civil law cases and the capacity of organizations in the chain (the four main organizations as well as probation service and Child Protection Board). The capacity of prevention programs and the Ministry of Justice were used as examples of variables outside of the model boundary. The diagram in figure 3 was used as an overview of the model.
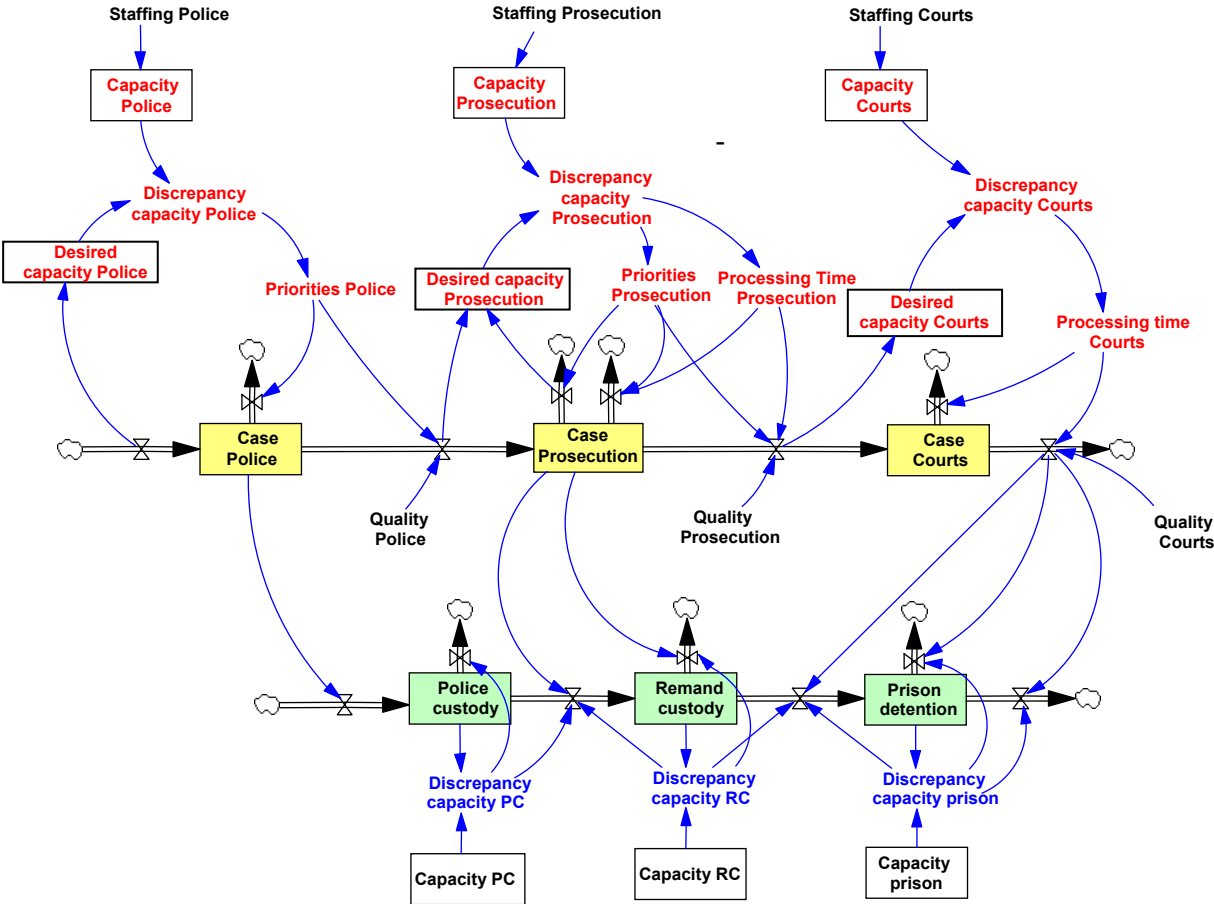

Figure 3. General overview of model, used in workshop 3

The upper part of the overview model shows the capacity of police, prosecution and courts. This capacity is used for processing the different phases of the case flow in the middle part of the figure. The police, for example, draws up a case report of a criminal offense and submits this to the public prosecution. This is the inflow to the work process of the public prosecution, which reviews a case and decides either to dismiss the case or refer it to the courts. The amount of cases and the quality of the work delivered by police constitute the case load for the prosecution, and in combination with

13

prosecution priorities determine which type and how many cases are dismissed. If the case load represents more work than can be handled by the available capacity of the prosecution, more cases will be dismissed. Similar processes operate for the police and the courts. The case flow drives the 'human flow' in which people are placed in different forms of custody, depending on the available capacity of each. Similar to the second workshop, the major activities in this workshop were two discussions in subgroups of about one hour each, each followed by a 15 minutes plenary presentation. Again homogenous subgroups were used. The first discussion concentrated on the submodels while the second focused on the connections between submodels. The third workshop concluded the conceptualization phase, which was to be documented in an intermediate report for participants and project administrators. The last part of the meeting focused on the intermediate report and the planning of the second (formalization) phase. In the formalization phase the submodels would first be formalized separately and then combined into one model in three iterations. The conceptualization report briefly addressed the goal of the modeling project and the process followed so far. The model in figure 3 was used as an overview of the submodels derived from the sessions. After summarizing the interrelationships of submodels in a table, about 40 pages of the report then laid out each of the twelve submodels in a diagram and text. The document ended by describing the three iterations and data needed for formalizing the model. The initial version of the conceptualization report received extensive comments from participants, leading to several rounds of reviews.

Formalization and testing phase

The formalization phase consisted of four workshops as depicted in table 3.

Workshop 4 April 22, 2004 2 hours	- Comments conceptualization report - Presentation submodels: status model and relation to other submodels, data sources used, data sources needed, presentation staffing submodels on general level, presentation assumptions submodels	- Workbook 4. 4p report and questions
Workshop 5 May 19, 2004 2 hours	- Reactions workbook - Presentation status data collection, translation into formal model and assumptions, status first iteration: case flow, staffing and person flow for adults - Operationalization three types of felonies - Runs submodels	- Workbook 5. 4p report and questions
Workshop 6 June 24, 2004 3 hours	- Reactions workbook - Presentation status data collection, translation into formal model and assumptions, status second iteration - Runs submodels	- Workbook 6. 5p report and questions
Workshop 7 August 19, 2004 2 hours	- Reactions workbook - Discussion in two subgroups? on diagrams submodels, third iteration - Plenary conclusion - Close project and drinks	- Workbook 7. 5p report

Table 3. Overview of workshops in the formalization phase

The sessions in the formalization phase to a large extent consisted of presentations on structure and behavior of submodels and specification of data needed. The role of participants was mainly to comment on structure and behavior, to assess important assumptions ('educated guesses') and to point to data sources such as publications and databases. Sessions generally lasted only two hours and were interspersed with one on one meetings in which submodels were discussed in detail with participants knowledgeable about that part of the system. The reports in this phase were also much shorter than the reports used in the conceptualization phase and primarily consisted of meeting notes in the form of bullet points.

The primary aim of this phase was to formalize the conceptual model. This was organized by assigning each submodel to two members of the modeling team: one principal modeler and a second modeler who would check work in progress. The principal modeler was responsible for data collection and contacts with data providers. He or she developed model structure and documented results in preparation of the final model report. Typically model structure was first checked with the second modeler and with the rest of the modeling team, then with a participant in a one on one session and finally presented in a session with the complete reference group. In addition the model structure and behavior was checked in internal quality assurance sessions. Data needs were first formulated on a general level and then specified by indicating the model variable and time units data were needed for. Each modeler kept a record in the form of a spreadsheet of model variables and data for his or her submodel. To ensure consistency of central terms across submodels, these records were combined in a complete list of variables at several times throughout the project. Participants in the reference group set up contacts with other members of their host organization if locating and accessing data made this necessary. In some cases data access was delayed because data were likely to be used in other research projects as well (such as the WODC) and thus a uniform way of reporting data had to be developed. Data on a couple of specific questions was not available in the host organizations and led to a number of visits to organizations not represented in the reference group. The training institute for public prosecutors and judges for example provided detailed information on this part of the model. The integration of the twelve submodels into one overall model was planned to take place in three iterations:

- Iteration 1. April and May (workshop 4 and 5): formalization of submodels on the case flow for police, public prosecution and courts, person flow adults, staffing and capacity police, public prosecution, courts and probation service. These submodels were then integrated into one overall model, by combining submodels one by one.
- Iteration 2. June (workshop 6): further refinement of submodels iteration 1 and formalization of submodels on the person flow of juveniles, staffing and capacity Child Protection Board and probation service juveniles, development of subscripts for person flows (in infractions, minor and major crimes). These submodels would then be added to the overall model.
- Iteration 3. July and August (workshop 7): formalization of 'mechanisms', integration in overall model and further refinement of model.

Each iteration resulted in a running and documented model that was submitted to project administration. Since a similar approach was used in all sessions in the formalization phase, we will only briefly report on each session.

Workshop 4, the first meeting in the formalization phase, started with a short discussion on the report of the conceptualization phase. The comments to the report again addressed the model boundary, as participants asked about the way forensic research would be incorporated in the model. In addition two sensitive topics were raised: the relation of the SMS model to the econometric models used by the WODC and the way in which releases 'at the front door' (sending convicts home until prison capacity was available) would be incorporated in the model. The decision was made to describe the relation of SMS to other models in a cover letter to be sent out with the final report. Releases at the front end of the person stream were politically very sensitive and could potentially draw a lot of attention. As the model was to represent the current situation, where there was only a minimal level of releases of this type, participants did not expect this to generate unwanted publicity. The workshop continued with a presentation of submodels in four steps:

- model: central assumptions such as processing time, priorities, relation processing time and outflows;
- relation to other submodels: in this session each submodel was largely made in isolation;
- data sources used so far: in this session usually written documents such as annual reports and WODC reports;
- data sources needed: most of the data in this stage would be used to check central assumptions formulated in the previous workshops. Each of the principal modelers prepared a set of questions on his or her submodel to be addressed in the workshop.

Workshop 5 followed a similar setup. As the development of submodels had advanced further, the integration of submodels received more attention this time. While in the previous workshop presentations mainly consisted of verbal descriptions, they now showed Vensim models and runs. For each model a base run and a scenario run was presented. Presenting model structure in detail made it easier to probe model assumptions in depth. For the capacity of public prosecution, for instance, a model assumption was that prosecutors would have to be present at court sessions. The participants agreed that this activity would take priority over all other tasks of a prosecutor such as processing of cases. A second example is the effect of processing time on dismissals due to the expediency principle. If processing time grows and approaches the maximum processing time as specified in the Code of Criminal Procedure, the number of dismissals will grow. The relation depicted in figure 4 was presented and discussed with the participants.
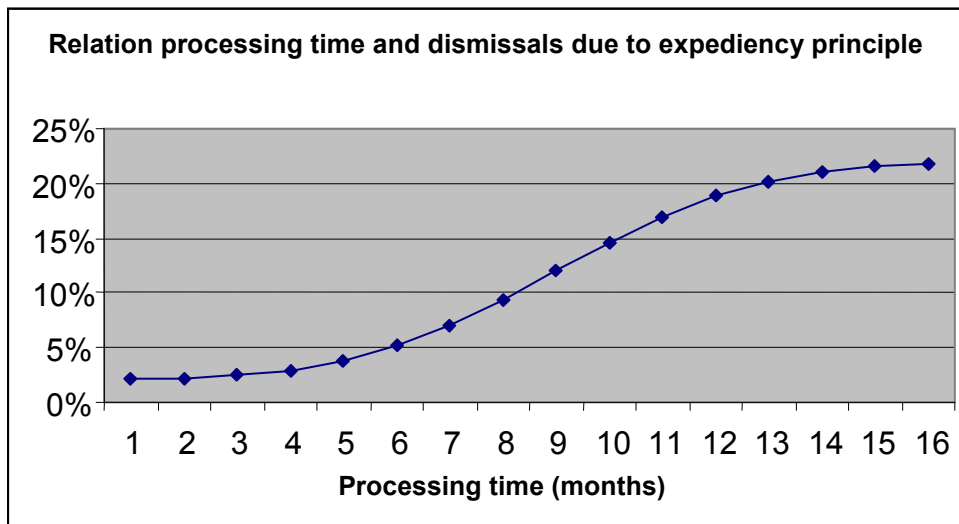
Figure 4. Assumption nonlinear effect presented in workshop 5

An important issue in this session concerned the operationalization of the three types of criminal offences on the basis of the duration of the prison sentence requested in the prosecutor's charge: up to one month for infractions, from one to six months for minor crimes and more than six months for major crimes. This categorization was based on the database used by courts (COMPAS).

The sixth workshop started with a report on the completion of iteration round one, and the plan for the next two iterations. In the second iteration round the person flow, case flow and staffing related to juveniles were modeled, additional submodels were integrated and another set of 'best guesses' were compared to data. The three types of offences were distinguished throughout the model. In this session the minor cases addressed in the Safety plan resurfaced. Please remember that these consisted of minor traffic offences and police arrests and amounted to 180,000 cases annually. Contrary to expectations, minor cases made a substantial demand on capacity of public prosecution and courts: of 9.3 million minor traffic offenders each year, 3% files for a court of higher appeal resulting in 280,000 cases annually and about 25 detention years. If a fine due to a minor offence is not paid on time the case appears before the cantonal (subdisctrict) judge, who may enforce a prison sentence. Cantonal cases were expected to result in another 200 detention years annually. In this workshop the first reference is made to the 'smoke detector' meetings, in which representatives of all organizations in criminal justice administration meet to discuss demand for detention capacity. These meetings have the role of an early warning system and aim to identify imminent shortages of capacity. Reports of these meetings could be used to validate the model. The session closed again with the planning of the remainder of the project.

The final workshop was not planned in the project proposal as discussed in January 2004, but deemed necessary to report on the progression of the model and for formally closing the model sessions. Before the meeting the submodels were almost completely integrated into one overall model. In the

session diagrams of each submodel on A3 pages of paper were handed out. The workshop started with a brief discussion of the report of the prior meeting. The check of data continued, for instance by disaggregating the relation between processing time and dismissals due to the expediency principle (see figure 4) to each of the three types of crime. Other nonlinear relations were discussed in the session, such as the effect of processing time of courts on the fraction of cases submitted to single judge (versus the full bench). The meeting then moved on to the points of integration between the submodels. This prompted a discussion on the role of supporting staff in infractions. Whereas in more serious felonies the capacity of prosecutors and judges determined processing time, in infractions the supporting staff had a more important role. The behavior of the overall model was explained by presenting and discussing three scenario runs:

- Scenario 1: 40,000 extra cases from police to public prosecution;
- Scenario 2: 40,000 extra cases from police to public prosecution plus 180,000 minor cases, both equally distributed over crime categories;
- Scenario 3: 40,000 extra cases from police to public prosecution plus 180,000 minor cases, both with a higher proportion of infractions and minor crimes versus major crimes.

The first scenario focused the attention of the reference group on the increase of the number of judges. Although the assumed increase was founded on a published source (Concept Wervingsprognose rechterlijke macht/ Concept Recruitment prognosis courts, Nov 2000) the participants questioned this assumption and it was subsequently removed from the model. The results of both other scenarios were recognizable to the participants and did not lead to questions. Participants discussed scenarios, steering variables and indicator variables that would be included in the final report and suggested only a few additional variables. The last part of the workshop was a brief discussion on further model validation, planning of the handover of results and procedure for further use of the model. The modeling team asked the reference group if they would participate in a final session a last look on the results of scenarios before these were sent to the Safety Taskforce. After the participants reacted positively, an additional session for this was planned for October. After the presentation of results to the Taskforce, separate presentations for all of the organizations involved and for the Ministry of Justice would be planned. The final model would be captured in a flight simulator and handed out on a CDrom to all participants.

Training phase and follow-up

The training phase included model documentation, handover and user training. The model was handed over on September 16, 2004. Handover was on schedule but with a 50% higher time investment by the external modelers than budgeted in the project proposal. In total the external modelers spent about 200 days and the two in-house modelers spent 320 days on the project. The increase in time investment resulted from three causes: additional reviews of the conceptualization phase report leading to a later start of the formalization phase, additional time needed for data gathering and an extra, unplanned workshop at the close of the project. The final version of the SMS

model was presented to the participants in the reference group in October 2004. A flight simulator version of the model was developed using Sable software but was never handed out to session participants. The modelers felt that translating proposed policies into changes in model variables, and again interpreting results would be difficult without intimate knowledge of the model and system dynamics. Instead they proposed to keep the reference group intact. If any organization involved in criminal justice would request to test a policy with the model, model changes and results would be discussed with the reference group to avoid misinterpretations of outcomes. Since both modelers of the Ministry of Justice were involved throughout the modeling process, no training in the form of an explanation of model assumptions and structure was needed. Instead both modelers participated in a two day seminar on group model building at Radboud University. After the finalization of the SMS model, both modelers paid onsite visits to the contributing organizations to present modeling results. The process and results of the model were (and are) met with enthusiasm in many organizations, resulting in a number of other group model building projects on topics such as DNA sampling, traffic fines, and impact analyses on new legislation and policies. The following table lists the system dynamics projects undertaken, starting with the SMS project in 2004.

1.	Model of the criminal Justice System (SMS)	2004, 2005
2.	Sampling and processing of DNA-samples	2004, 2005, 2006, 2007
3.	New options in prosecution	2004, 2005, 2006
4.	Planning of arrests of sentenced criminals	2005
5.	Enforcement of speed limits in relation tot traffic safety and fines	2006
6.	Forensic care	2006, 2007
7.	The effect of more junior crime scene investigators	2006
8.	Conditional release of prisoners	2007

Table 4. Overview system dynamics modeling projects at the Ministry of Justice since 2004

Results of the SMS project were disseminated beyond the reference group in a number of ways. The Ministry of Justice announced the completion of the modeling effort in its communications on the Safety Plan. The flight simulator was used in training of new employees for different departments of the ministry, and was the basis of a criminal justice board game handed out to all employees. At several moments throughout the course of the SMS project, participants in the modeling session brought up the relation to the econometric models of the WODC. In April 2005 a meeting at the WODC office was held in which most members of the project team and about fifteen WODC researchers and manager. After a presentation of the SMS model, the discussion focused on

differences between system dynamics and econometric models in a general sense and the specific assumptions in the SMS model in particular. In particular the modeling of 'soft' assumptions, for instance the mechanism described in figure 1, generated interest. The ability to compare different scenarios, varying for instance the degree to which judges reacted to early releases, was helpful here. The feeling after the meeting was that both approaches complemented one another and WODC researchers expressed interest in learning more about the system dynamics approach. As a final quality test of the modeling work, an independent consultancy firm was asked to provide a second opinion on the process and product of the modeling effort. Model analyses and data from interviews with participants and modelers were compared to the best modeling practices described by Martinez and Richardson (2001) and standard validity tests (Forrester and Senge, 1980; Richardson and Pugh, 1981; Sterman, 2000). The report was finalized in August 2005 and concludes that both the modeling process and resulting model are of high quality.

In addition to answering the original questions, the model was also used to gain insight into the effects of a proposed law. Under the new law, the public prosecution will settle a proportion of cases which are now the responsibility of courts. Several members of the original modeling team participated in an update of the SMS model which was finalized in March 2006. The modeling effort pointed to larger than expected case loads at several points in criminal justice administration, for which IT systems would need to be adapted. As a result implementation of the law reform was postponed for one year.

Reflection on modeling process

In this section we put the detailed description of the modeling process in perspective, by confronting it with modeling scripts reported in the literature. We first use Andersen and Richardson's (1997) original article on scripts and later work in this tradition (Cresswell et al., 2001; Richardson et al., 2004; Andersen et al., 2004; Zagonel, 2004 and Luna-Reys et al. 2006) to frame the steps followed in the SMS project. We then identify other important steps in the modeling process and relate these to the Andersen and Richardson's guidelines. Finally, we attempt to capture essential elements of smaller parts of the program by reframing them as scripts. We interpret scripts as elements of the modeling sessions, meaning that all steps in preparing sessions and work in between sessions are captured under principles. The additional scripts are not new. In some cases they build on the guiding principles that underlie Andersen and Richardson's (1997) scripts, and in other cases they continue work by Vennix et al. (1992); Vennix (1996), Ford and Sterman (1998) and others. Below we list scripts we feel are completely or in part used in this project, and the corresponding activities.

Audience, purpose, and policy options (Andersen and Richardson, 1997: 118). This script aims to clarify the audience for a modeling study and then proceeds to identify the policy levers for influencing problematic behavior. Andersen et al. (2004: 16) develop this idea further by categorizing

stakeholders on the basis of their influence and interest with regard to the issue at hand, and then clustering policy options. In the SMS project policy options were addressed in the interview round with participants. The question on purpose and involved organizations was addressed in the first workshop and resurfaced in the third meeting when model variables were categorized into different types.

Sectors, a top down-approach (Andersen and Richardson, 1997: 119). This script asks participants to think through what might be the key sectors in a system that is going to be modeled. The interviews in the SMS project led the modeling team to the person and case flow and the identification of four central organizations in the criminal justice system. This assumption was then checked with the participants, which led to the conclusion that part of the case processing by the probation service and Child Protection Board would need to be included in the model.

Capacity utilization script (Andersen and Richardson, 1997: 121). This script aims to elicit feedback structure by asking participants to compare two levels and talk about what will happen if the two levels get far out of alignment. This script was used to compare desired to maximum detention capacity (in the early releases mechanism and in the person flow) and actual to desired workload (in the reaction to workload mechanism). Towards the end of the conceptualization phase, the question on how organizations changed their activities depending on workload was addressed in more and more detail.

'Black box' means-ends script (Andersen and Richardson, 1997: 122). This script comes down to first diagramming the stock&flows structure of part of the system and then adding key outputs and policy levers in a series of layers. This finally results in a 'transparent' or 'white box' view of the system. By going back and forth between the case flow, person flow and mechanism of reactions to workload, the initial bare stock&flows description was filled out in a series of steps. For the main organizations in the chain, processing of cases and reactions to workload were identified. Policy levers and key outputs were compared from one organization to the next. At the end of the conceptualization phase, this process was repeated for the probation service and Child Protection Board.

Eliciting mental model-based policy stories (Andersen and Richardson, 1997: 124). This was done in the interviews, for instance when a judge described the impact of early releases.

Data estimation script (Andersen and Richardson, 1997: 123). This script boils down to asking participants for numerical values for particular model variables individually, and then comparing values across group members. In the formalization phase parameter values were frequently first derived from literature or one on one interviews with members of the reference group. Values were then presented in workshops to allow the complete group of referents to check assumptions.

Model refinement script (Andersen and Richardson, 1997: 123). In this script a diagram of model structure is handed out on a slide or paper sheet and the facilitator takes participants through the model one item or line at a time. Individuals or small groups may add to the diagrams. In the last three sessions participants received handouts depicting stock&flows diagrams and the principal modeler would lead the participants through a submodel. We also worked from general to more specific mechanisms by starting out form the general mechanism on dealing with excess workload and refining this for each specific organization in criminal justices administration. Archetypes, canonical models and Vensim molecules inspired other parts of modeling structure.

Create a matrix that links policy levers to key system flows (a 'system impact' matrix, Andersen and Richardson, 1997: 124). This script assumes that a 'white box' view of the system and a list of policy levers exist. The script then boils down to filling out a matrix of policy levers by key flow variables, noting in each cell the extent to which a policy has an impact on the variable of interest. In the conceptualization phase of the project three tables were used to compare model elements in a qualitative fashion. First, the table used in the second workshop (table 2) compared three model sectors between the four main organizations in criminal justice administration. Second, variables were placed in different categories (endogenous, exogenous, indicator and outside of model boundary) to clarify the model boundary in the third workshop (cf. Cresswell et al., 2001). Third, in the report of the conceptualization phase a table is formed by listing the twelve submodels in both the columns and rows, and describing their main interrelations in each cell.

Scripts for 'ending with a bang' (Andersen and Richardson, 1997: 125). These scripts aim to end a group session on a positive note, for instance by closing with policy insights in the form of easy to remember chunks of insight that people can carry away. In the last session the scenario runs provided preliminary high level insights with regard to the central question in this modeling effort (the effect of an increased case load).

From the overview of the modeling process in the preceding section we deduce the following guiding principles that seem to complement the principles listed by Andersen and Richardson (1997). The first addition is a round of interviews with members of the reference group in preparation of the modeling sessions. Andersen and Richardson (1997: 109) list interviews with the gatekeeper and other key managers in which the problem for the sessions is framed and an initial plan for the project is drawn up. In our case this discussion with the gatekeeper was indeed the starting point for the project, but an additional series of interviews was held with members of the modeling group similar to the approach described by Vennix (1996: 116). A second principle also discussed by Vennix (1996: 128) is the use of workbooks to capture results of sessions and prepare for follow-up meetings. A third point we noted in this and other modeling projects is the importance of participants' attendance to modeling meetings. We feel that if at all possible, one should avoid changes in the reference group. Rouwette and Vennix (2007) note that many of the insights obtained during a session seem difficult to transfer

on paper, either in the form of workbooks or reports. Even when a person has read the last meeting's notes, a participant who has missed out on the last meeting seems to need time to get back into the frame of mind and reasoning of the reference group.

The next couple of principles focus on capturing and holding the attention of participants in the modeling effort. A fourth point is that the interest generated by discussions on content should not be underestimated. The modeling team in the SMS project felt that the most important reason for an audience of high ranking professionals and experts to keep on attending lengthy modeling sessions was the fact this was a forum to hear first-hand from other experts how other parts of the criminal justice administration operated. The meeting offered an opportunity to learn about the argumentation of the other partner organization in the chain. The mechanism of early release shown in figure 1 is an excellent example of this. A conversation on the 'real' operation of the chain can usefully be contrasted with a politically or financially motivated discussion. In a subsequent project on traffic fines financial concerns were paramount throughout the venture. Even when the modeling team had ensured participants that their views were paramount and modeling products would not be used as arguments to increase fines, the issue never really seemed to be settled. The subject resurfaced at inopportune moments and led to one participant withdrawing from the reference group. A fifth concern is the position of system dynamics versus other modeling approaches used by the host organizations. This point is related to Andersen and Richardson (1997: 109) principle of clarifying modeling products. This is however somewhat of a dilemma, as they also stress that it is not useful to spend much time on explaining what system dynamics is (the 'start with a bang' script). Maybe this question will need to be addressed outside of a session, but it seems important to deal with. Other models and modeling approaches are bound to be used by one of the organizations participating in the modeling project, which means that questions on their place relative to one another are likely to arise. Managers are eager to avoid different outcomes from different models on one and the same problem. A useful approach in the SMS project was to fully acknowledge that the system dynamics model was based on data gathered for (and generated with) other models, and stress that the approaches were not competing but answered different types of questions. The fifth principle is to plan for data gathering. The fact that in this case data for the system dynamics model would also be input to other models prompted the development of a formal procedure to derive data, with the intention to avoid inconsistent results. The sixth and final principle is supervision of model use in the form of a management flight simulator. Handing out a flight simulator for individual use proved unfeasible in this project. Instead the reference group continued to be consulted for interpreting model outcomes. The flight simulator was also used in training workshops for new employees of the Ministry of Justice. These results point to the conclusion that unsupervised use of a flight simulator, at least in the case of a complicated model as in this case, seems difficult.

In addition to these principles, we attempt to reformulate a couple of elements of the modeling sessions into scripts.

Team of teams script. We name this script after the procedure formulated by Graham and Walker (1998) for managing a modeling project with a large group of people. In the formalization phase of the SMS project, submodels were assigned to a principal modeler who developed model structure and coordinated data gathering. The principal modeler presented his or her work to the other team members and the reference group. The consistency of model variables was guarded by regularly updating a list of variables and their definitions. This proved to be an efficient way of working. In a follow-up project the division of work was not as clear, which led to overlaps in development of structure and to modeling problems coming up for discussion in the modeling team over and over again.

Concept diagram script. The use of concept models is described by Andersen and Richardson (1997: 116) and in other work on scripts mentioned before and is extensively discussed by Richardson (2006). This application centers on the use of a formal concept model and derive much of its use from iteratively building model structure and showing changes in model behavior after each addition. We use the term 'concept diagram' to refer to a conceptual or qualitative model (see also Vennix, 1996: 113). In the SMS project preliminary qualitative models were used at several points in the process. Part of the interview results were captured in causal loop diagrams, describing so-called mechanisms of how policies in one part of the criminal justice system had unexpected effects elsewhere. In addition the stock&flows diagrams on the person and case flows were used as inputs for workshop discussions. The decision to use the stock&flows models was in part made because flowcharts of work processes were common in the various organizations involved in the project. Thus we expected participant to recognize the content of the diagrams while at the same time getting accustomed to the system dynamics notation.

Elicitation of nonlinear relation script. Ford and Sterman (1998) describe a stepwise procedure to guide experts in sketching a nonlinear relation between two variables, with careful preparatory work and explanation of measurement scales. Mooij et al. (2001) use this procedure to relate more than two variables. Part of this process was used in the formalization workshops, for instance when explaining the relation between processing time and dismissals.

Putting a stake in the ground script. An excellent way to generate participant's interest and involvement is this procedure outlined by Richmond (1987; 1997). Participants are asked to predict the results of a modeling experiment. Often the differences between predictions already generate lively and fruitful discussions. If predictions differ from outcomes, effects can be traced through the model structure to explain observed behavior. The outcome is an improved model or a change in insights, and often a combination of these two. When presenting model behavior in the formalization phase, this procedure was used when time permitted. In the last session the scenario runs presented in this fashion certainly contributed to a project 'end with a bang'

Conclusion

Going directly against the advice to 'end with a bang', an important question to address in this last section is: what could we have done better? In hindsight the modeling team feels that some of the presentations were too long, which conflicts with the guiding principle 'avoid talking heads' (Andersen and Richardson, 1997: 115). In addition, we could have avoided ending sessions in an evaluative mode and instead summarize key insights. This reflects the ending with a bang principle (Andersen and Richardson, 1997: 116).

In summary the model team's evaluation of this project is very positive. A formal evaluation with participants did not take place, but reactions from various sides indicate enthusiasm for the system dynamics approach and participants' active role in model construction. The follow-up projects point in the same direction. In this paper we attempted to clarify the process of group model building, which hopefully makes it easier to disseminate insights and build on these in future modeling efforts. Another important topic for future research is why modeling seems to have fallen on fertile ground in this case. Why has system dynamics generated interest and enthusiasm in this case and not in others? Earlier system dynamics modeling projects at the Ministry of Justice were short-lived and did not lead to follow-up projects. In addition to formal evaluations and attempts to draw out process insights, more clarity on the factors that inhibit or promote the use of system dynamics modeling would be useful to guide future work.

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