ANALYSIS OF PROJECT MANAGEMENT PROCESSES AT A DUTCH PUBLIC INFRASTRUCTURE AGENCY USING GROUP MODEL BUILDING

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ABSTRACT

System dynamics has been widely used for solving complex problem. The combination of system dynamics modeling process incorporates implementation or use of the model as the final process of system dynamic modeling yet implementation is always the most difficult part in any organizational changes. Implementation often becomes its own issue, client may not understand how the policy will work to solve the problem or the other possible case is consultant may not understand the underlying problem. The messy problem condition occurs in Rijkswaterstaat (RWS), one of the directorates from Ministry of Infrastructure. RWS' duties are to develop, maintain, and operate traffic infrastructure throughout Netherland. Financial sector of organization is seen as a more obvious problem than communication problem which finally makes the organization is aware of the implicit problem. Based on the issue explained by stakeholders, GMB is seen as a suitable method to capture the problem. The primary goal is not to build *the* model of *the* system, but rather to get a group engaged in building a system dynamics model of a problem in order to see to what extent this process might be helpful to increase problem understanding and to devise courses of action to which team members will feel committed.

INTRODUCTION

System dynamics has been widely used for solving complex problem. The combination of system dynamics modeling process by Randers (1980) and Richardson and Pugh III (1981) incorporates implementation or use of the model as the final process of system dynamic modeling yet implementation is always the most difficult part in any organizational changes. Implementation often becomes its own issue, client may not understand how the policy will work to solve the problem or the other possible case is consultant may not understand the underlying problem. Schein (1990) explains three models of organizational changes (1) expert mode, (2) doctor-patient mode, and (3) process consultation. If those three models are connected with implementation issue, Vennix (1996) explains process consultation as the most suitable for organization intervention which often deals with messy problem. Vennix (1996) defines messy problem as a condition with no 'objective' problem or only situation defined as problem by people.

Group Model Building (GMB) is a group facilitation process that combines process consultation and system dynamics. GMB uses system dynamics as visualization tools to capture complex problem. System dynamics is used than other model because it uses structure with line and variable which is easy to understand even for those who have never interacted with it. Process consultation, on the other hand, is used to elicit the problem from stakeholders' perspective instead of consultants' assumption. GMB has been widely used (e.g,, Bleijenbergh, Benschop, & Vennix, 2013; Eskinasi, Rouwette, & Vennix, 2009; Rouwette & Vennix, 2003; Vennix, 1996) to solve messy problem in organization. The characteristic of messy problem that it cannot always be captured quantitatively makes the issue is even more complicated.

The messy problem condition occurs in Rijkswaterstaat (RWS), one of the directorates from Ministry of Infrastructure. RWS' duties are to develop, maintain, and operate traffic infrastructure throughout

Netherland. RWS' job description is mostly about procurement process for developing, maintaining, and operating current infrastructure to fulfill the infrastructure's function. Procurement process is a long process that incorporate different entities both form internal organization and external organization (supplier). Various entities and different process for every project create complicated issues every time new project is taken place. The problem itself, as explicitly stated by stakeholders, is a common communication and organization problem yet the problems create high project cost which gives implication to financial sector of the organization. Financial sector of organization is seen as a more obvious problem than communication problem which finally makes the organization is aware of the implicit problem.

Based on the issue explained by stakeholders, GMB is seen as a suitable method to capture the problem. The primary goal is not to build *the* model of *the* system, but rather to get a group engaged in building a system dynamics model of a problem in order to see to what extent this process might be helpful to increase problem understanding and to devise courses of action to which team members will feel committed Vennix (1996). The goals of GMB are communication, commitment, insight, and consensus Vennix (1996).

This paper aims to show the implementation of participatory group model building process in a complex issue by involving participation of stakeholders who will develop understanding of underlying problem and also as entities that will implement the policy.

THEORY AND LITERATURE REVIEW

Rijkswaterstaat (RWS) is one of directorates in Ministry of Infrastructure in Netherlands. Rijkswaterstaat is responsible for water protection, water quality, road and waterway traffic, and reliable traffic-related information management.

The Dynamics Traffic Management (DVM) system (one of the RWS' departments) is a 20 years old system and continuously developed by the adding one equipment to another and makes it works together with older equipment. To add the one equipment to another creates new project and each of the department needs to coordinate to accomplish the project. There is also a major re-organization in RWS which makes the position of each department slightly changes and therefore conditioning people to adapt more as well as continue to coordinate the project routine.

The project-focus main job description yet has project organization and regional organization structure makes the flow of the information of a new project is not understood clearly by each of the department. Project-based organizational structure which is usually used by another organization to make the projects run smoothly is not possible since the projects appear unscheduled and based on ministry's instruction, user of information system, road user, or regional partner.

RWS will face budget cut in several years yet the project will still be developed and existing systems need to be maintain. In order to balance the financial activity and the basic activity, RWS stakeholders think that they need to make the project and maintaining process leaner than before. The lean project and maintaining activity can be achieved by share the same understanding of the right process in the system because currently there is a tendency each department does what they think good for RWS without any need to coordinate with other.

Problem that had been proposed by the group in the model building session was "How are the processes[1] at RWS interrelated and how is this related with achieving the outcomes desired by the minister?" The problem does not seem to be transparently dynamic. Modelers' team also saw it, but the initial

[1] The processes mentioned are: Lifetime Maintenance, Procurement, Technical Development, Operations, Controlling, Policy Advise

requirements for the project were to use system dynamics and group model building to investigate this problem. Many times consultants can faced with the situation when he/she should deal with clients desires, which is why it is quite important to be able to adjust problem definition to the desired framework in order to satisfy clients' requirements.

Because of specific of company's work, project management modeling examples were appropriate to start work with. Cooper (1980) described relationships between contractors and the company, which are close to Rijkswaterstaat situation. Ford and Sterman (1998) presented in their article product development process: how performance is depend on scope, resources and process structure (see Figure 1).

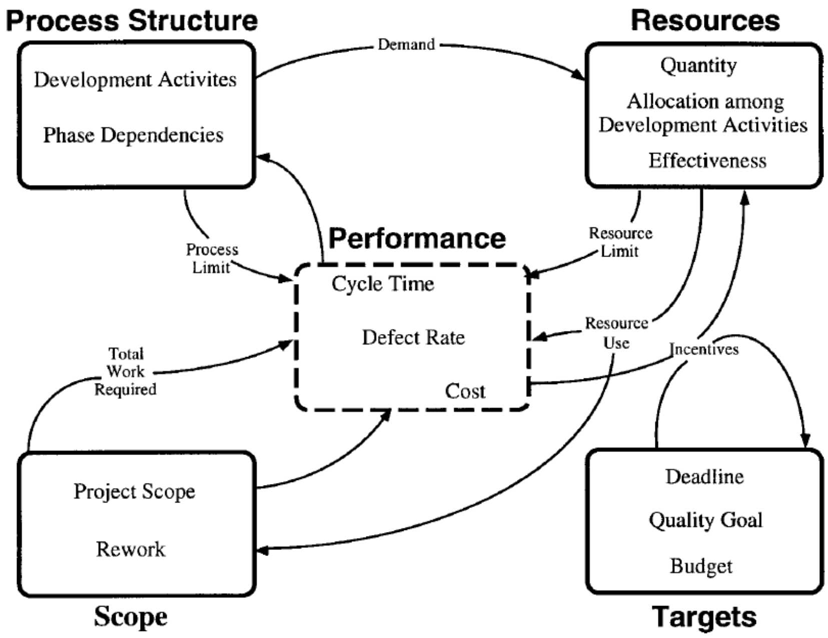

Figure 1. Model subsystems in a single development phase used in the positioning phase (Ford & Sterman, 1998)

Project management structure is able to help in understanding delay process: when some parts of the projects are still not complete it creates bigger delay in the all work.

METHODOLOGY

The approaches of this research are action research development through case study using Group Model Building (GMB) and system dynamics approach. Action research is conducted with aim to direct a change in the organization while system dynamics is used to help participants understands the issue. Action research has been widely used before (e.g., Abraham and Purkayastha (2012), Drake (2013), and Loizou (2013)) as a methodology to help participants developing own understanding of the issue, to generate theory and develop skills to cope with the issues (Loizou, 2013).

Action research challenges the claims of a positivistic view of knowledge which holds that in order to be credible, research must remain objective and value-free (Brydon-Miller, Greenwood, & Maguire, 2003). (Brydon-Miller et al. (2003)) also mentioned that action research, as well as GMB, embraces the notion of knowledge as socially constructed and recognizing that all research is embedded within a system of values and promotes some model of human interaction; action research commits to a form of research which challenges unjust and undemocratic economic, social and political systems and practices.

Similar to other system dynamics model, this study also stress on qualitative data. The different of action research, in this case GMB, to another common consultation process is the qualitative data is the combination from various stakeholders' perspective which give opportunity of stakeholders to reconfirm their ideas and assumptions of the process.

In this study, system dynamics is used to capture the relationship of each process. The process is derived from stakeholders' perspective. Stakeholder is also asked to explain variables that affect each process. The model development is conducted based on stakeholders' issue interest. In the second GMB session, stakeholders prefer to concentrate on implementation process to accommodate interests of every entity in the session.

PROJECT PROCESS

The project was done by a student team consisting of 4 participants of different nationality who worked on the project during October 2013 to January 2014 at the Rijkswaterstaat's office in Delft and Utrecht.

The phases of the project were as follows:

1. The team held several scoping interviews with representatives of different departments at RWS, to develop an overview on what exactly to model during the project.
2. Building on the scoping interviews, the team scheduled three half-day modeling sessions at the RWS office.

First Session

In the first session, the scope of the project was developed. Major results were the problem definition and the (fictional) case study example, to explain it. A considerable amount of time was invested here. This proved helpful in the later stages. To reiterate: The problem definition the group agreed on was *"How are the processes at RWS interrelated and how is this related with achieving the outcomes desired by the infrastructure minister?"*, and it was furthermore agreed to show this by the fictional example of Implementing a ministry directive to lower travel time around the city of Utrecht for 20%. Also, some input was gathered on how implementing this directive would happen in real life and which processes would be working together inside RWS to accomplish this.

Second session

Before the second session, the team had assembled the loosely structured input from the first session into a System Dynamics model. In the second this model was discussed for validity and developed further. Towards the end of the session, it was proposed to focus quantification on one part of the model, namely the actual construction of new assets.

Third session

In the third session, the team showed the functioning (quantified) System Dynamics model and discussed policies with the attendants. Policies were evaluated by their effects on the construction time of new assets and their extra workload for RWS personnel.

Results

The main result of the sessions was a partly quantitative simulation model which could be used to support policy decisions and guide further interventions. In terms of concrete policy recommendations, the team identified the importance of involving construction contractors early on, and empowering them to deliver better quality through several ways (eg. training).

Other results were the identification and representation of interdependencies between the different departments of RWS, which lead to an improved and shared understanding of the RWS organization among the attendees. Vennix (1996) considers building shared understanding among attendees as a valuable result in itself. This was possible by enabling a constructive, solution-focused discussion using the model.

Next steps

While the model already identified some sources of issues and gave some policy recommendations, we see it as critical to include a number of other processes into the model. Most importantly it seems to us to include the process of knowledge/information generation, and knowledge transmission. For this, communication flows inside and outside of RWS and issues of manpower capacity in the various departments also play roles.

DESCRIPTION OF FINAL MODEL

The final model represents, how a directive by the ministry will be dealt with in the various departments at Rijkswaterstaat - how it will be discussed first (1), then translated into a project plan (2) , which then goes into construction through the contractors (3).

This final construction process is analysed in more detail, since the participants proposed in the second session that this would be a good approach to use the limited time. It is only this final part of the project development chain which is quantified and able to simulate.

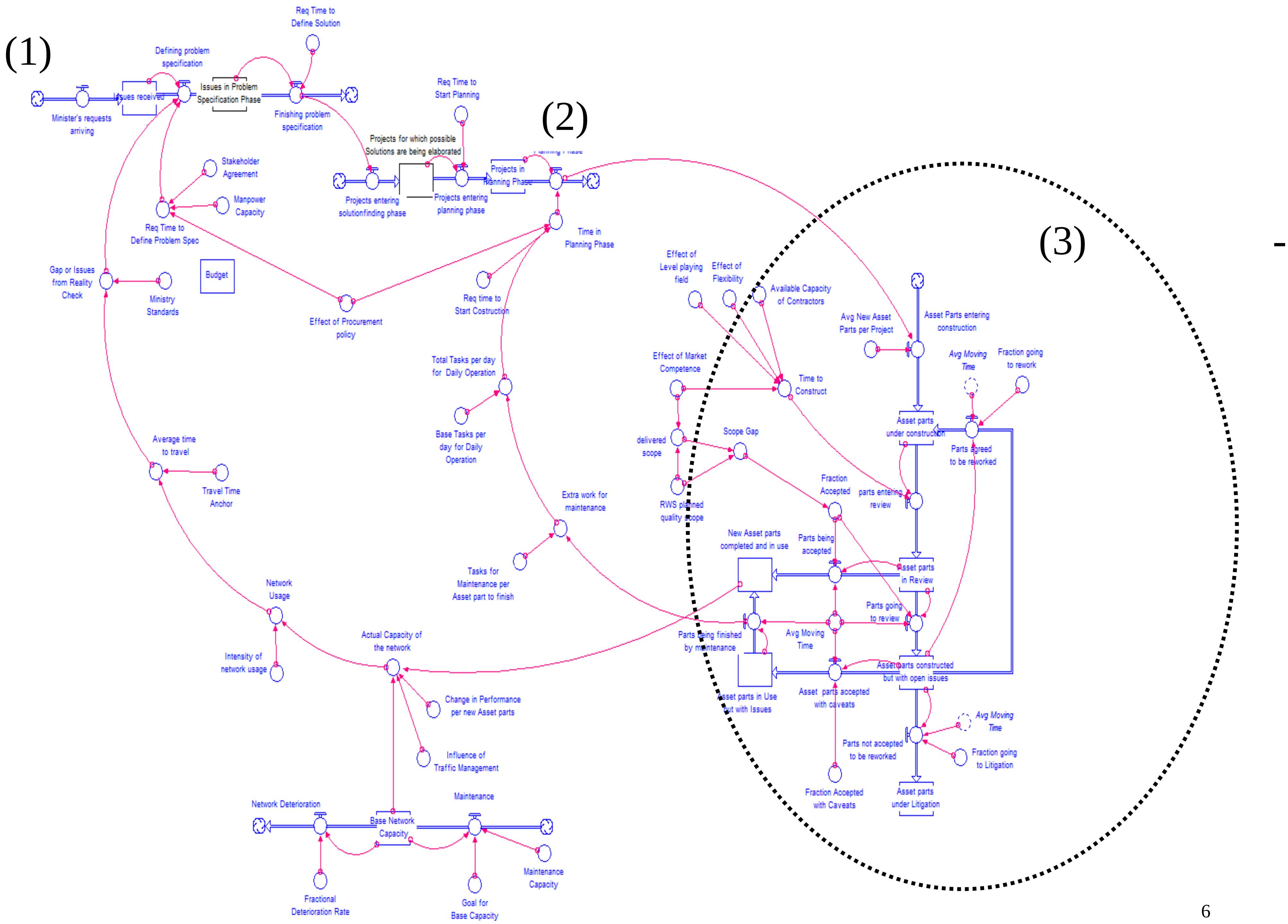

Figure 2: Model overview - Qualitative and Quantitative

In this quantified focus part of the model, an asset project which is to be constructed consists of 1000 generic "asset parts". Those asset parts spend some amount of time in the construction phase and move from there into the review phase, where RWS checks the quality of the asset that has been constructed. Depending on the Fraction of those asset parts which RWS accepts (those which meet the standards), some of the asset parts move from "Review" to "Completed and in Use", and some of the asset parts (those which RWS does not accept) move to "Asset parts constructed but with open issues". The former option is the optimal situation, the latter is the suboptimal situation. At this point, there are three options of what can happen to the flawed asset parts - they will either

1. be agreed to be reworked by the contractor companies, which means they reenter the process at an earlier stage
2. go to mitigation, where RWS will go to court to decide what happens
3. they will be taken into use, however with issues. This means that they add to the network capacity in a limited way, however it is up to maintenance personnel to finish the construction of the asset. This procedure will naturally result in an extra amount of daily tasks for maintenance personnel, which will add to their baseline of tasks.

Starting from this structure, policy interventions can affect at the system at several places

1. The time that it takes for assets to be constructed
2. The fraction that is being accepted of the constructed parts
3. When asset parts do not pass the review stage and go to "Open issues": The fraction of asset parts which takes each of the three options mentioned in the earlier paragraph (Rework. Mitigation or Finalisation through Maintenance personnel).

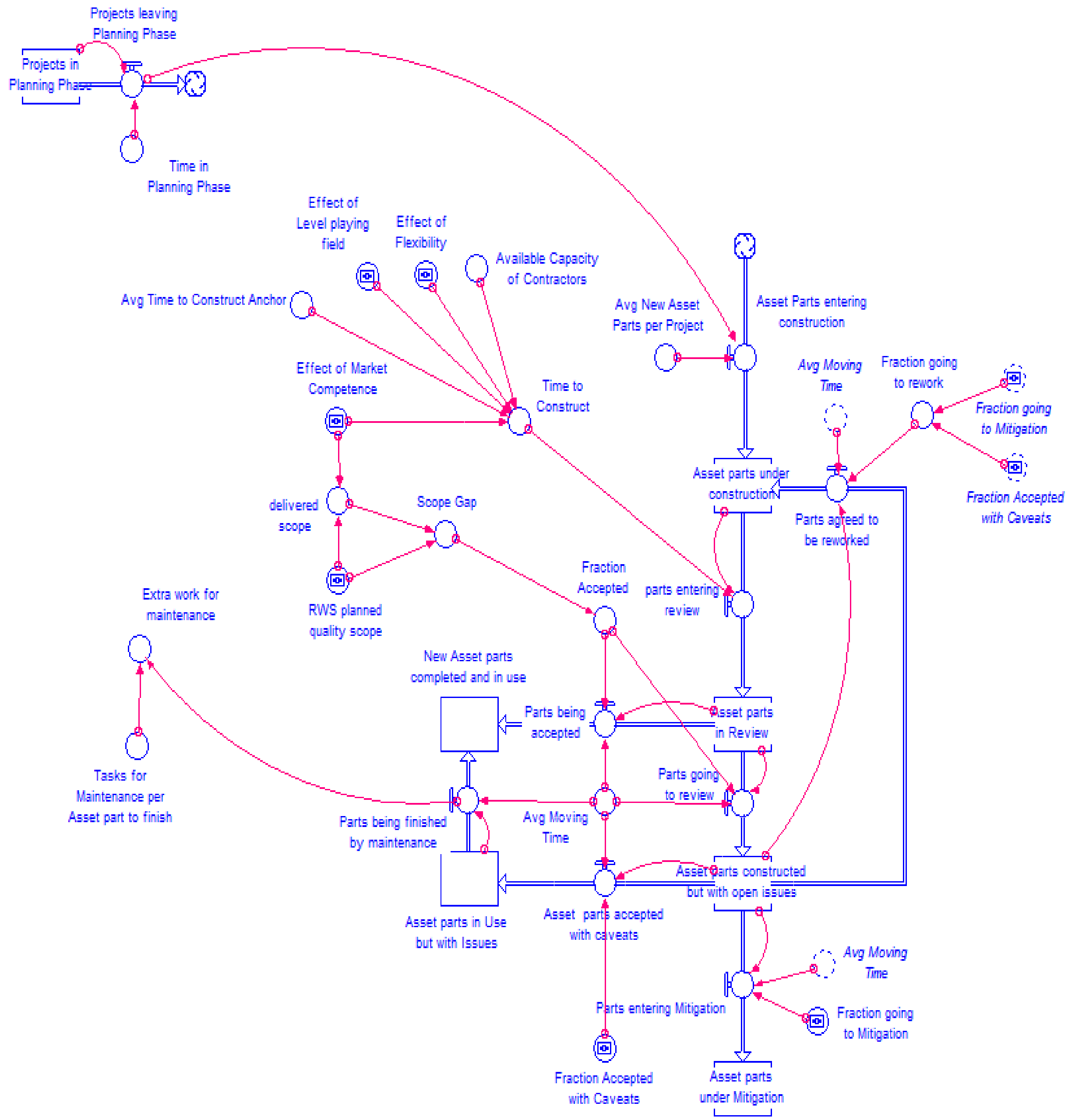

Figure 3: Quantitative part (Asset Construction)

SIMULATION RUNS

From the implementation part of the model, simulation results can be obtained. Four parameters were used to run the simulations for the exercise. That means first a graph is drawn without any changes to a parameter. And second is that there is a graph drawn with changes to one of the following parameters:

1. Effect of level playing field;
2. RWS planned quality scope;
3. Fraction accepted with caveats;
4. Effect of market competence.

As tested values were used two key indicators:

1. New asset parts completed and in use (how fast and full the assets are finished);
2. Extra work for maintenance (if some asset parts have to be finished by RWS it creates extra work for maintenance).

The changes in new asset parts completed in every parameter changes is not significant the following graph will show the changes of indicator as the effect of parameter changes:

1. Policy of increasing level of playing field

This variable shows how much RWS dictates to the contractors what they want. ("If RWS just dictates and says this is what we want, there is no or a small playing field. This would be a variable which would be under the control of RWS, however it means neither the time which is required for the asset to be completed will get much smaller nor will maintenance see a big change in their extra work. Looking back to the model structure, it may happen due to the fact that it only influences one small part of the system (time to move to review stage), however all other system parts stay equally in place. The graph show that changes in this direction will not lead to changes in the behaviour.

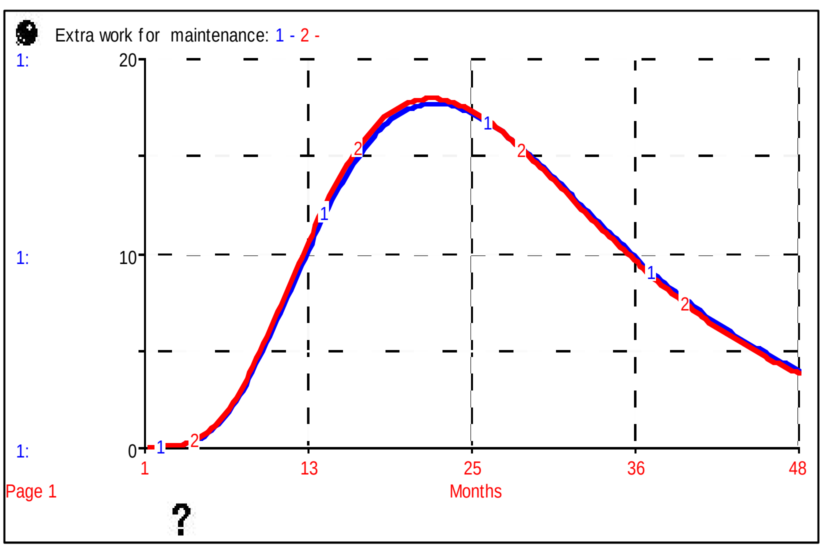

Figure 4. Policy Run Results for changes in level playing field

2. Policy of changing RWS planned quality scope

The meaning of this variable is how much RWS wants from the constructors, how full all requirements are described. In the interviews it surfaced several times that RWS planners have very high standards for the infrastructure for various reasons, which in some cases may lead to adverse effects at other system parts like budgetmaking. In the simulation where RWS decides to lower their expected quality standards (eg. from "outstanding" to "good enough") a small increase in time to construct and a moderate decrease in "extra work for maintenance" was resulted. The decrease in quality scope brings less extra maintenance work.

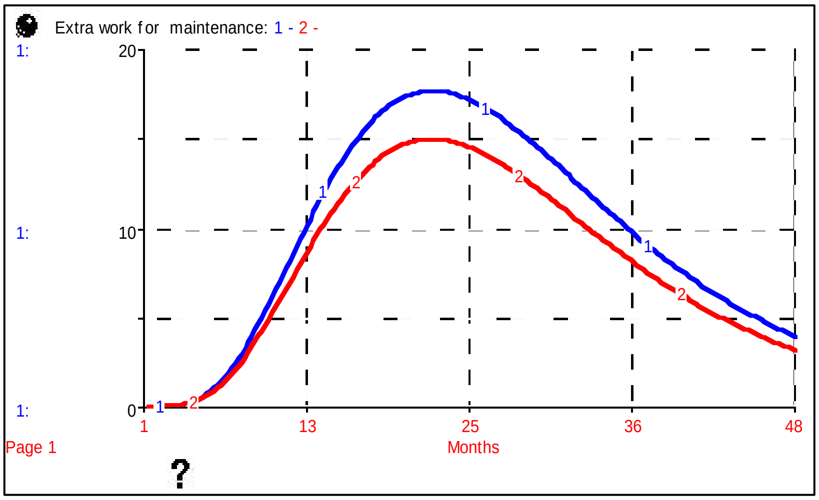

Figure 5. Policy Run Results from Changes in Planned Quality Scope

3. Policy of changing fraction accepted with caveats

This variable shows a percentage of work which will be accepted with caveats. It is increased 2/3 times the initial value. This results in a small decrease in construction time and a very large increase in extra tasks for maintenance (from 19 to 30 per day). This is a good example of unintended consequences of policy on system parts which are hard to forecast.

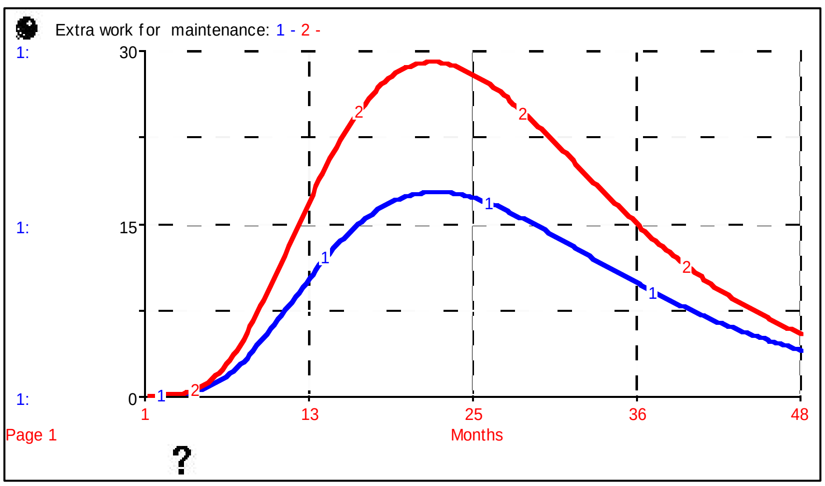

Figure 6. Policy Run Results from Change of Fraction Accepted with Caveats

4. Effect of Market Competence

This effect shows how good the market competent is, how well the market is trained by RWS. These graphs show that extra maintenance work will decrease significantly. A significant decrease of construction time and a big decline of tasks for maintenance (from 19 to about 8 tasks per day) are seen on the graph. The success of this policy lies in the fact that it intervenes the system at two points - the time to construction (1) and the quality, leading to fraction of assets accepted (2). Parts will arrive earlier and with a higher quality, leading to less parts which need to be reconstructed or bringing extra stress to maintenance personnel.

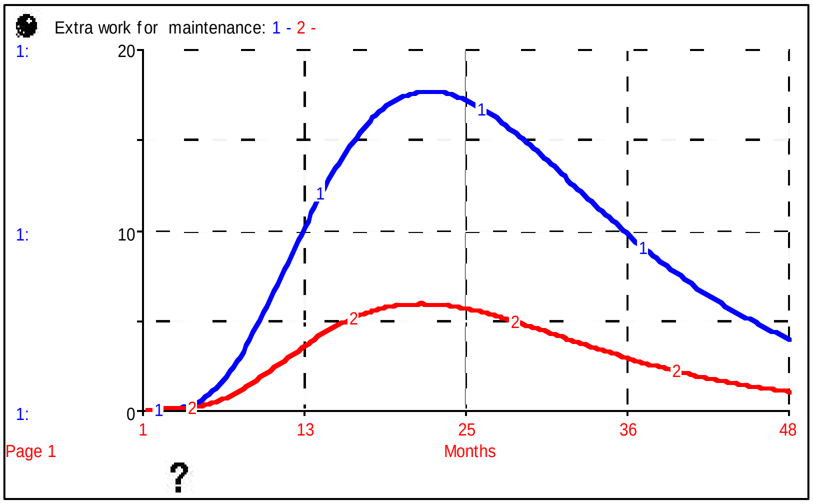

Figure 7. Policy Run Results from Change of Effect of Market Competence

CONCLUSION

We presented an application of quantiative System Dynamics for Group Model Building at a major infrastructure agency in the Netherlands. A first round of sessions has been concluded and the project is set to continue in the near future. We showed a proof of concept for using Group Model Building to analyse and model complex interrelated organisational processes. The use of System Dynamics-based Group Model Building is chosen to help facilitate productive discussion and provide meaningful decision-support for policy making.

In the end of the process, participants got counterintuitive idea about the procurement process in the organization. This is the result that was expected in the beginning of the project. Although many previous studies produce sound result use qualitative modeling, this study produce counterintuitive result from model runs.

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