

Development of multiplayer games through group modelling

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Abstract

Group model building can be used as a tool to increase the efficiency of game development. In a development project done for an Air War College, group model building was used as a core method to create a multiplayer, decision training game. The method made it possible, within two working days, to progress from the first meeting between domain experts and modeller to a tested, multiplayer game. The development work was perceived as involving college instructors in a positive and useful process of knowledge elicitation and sharing. The final product was evaluated by both instructors and students as a suitable tool for decision-making training at strategic level. At the same time the development required very limited use of resources.

Background

Involving clients has always been an important issue in System Dynamics. At the beginning of System Dynamics, client involvement was seen as an important technique for eliciting knowledge during the modelling process (Forrester 1961). Later studies have supported the concept of client participation as a highly efficient way of improving knowledge elicitation for model development (Rouwette et al. 2002). It has also become evident that that deep client involvement contributes to the learning process among the participants in the modelling group (Morecroft 1992, Lane 1992). It also seems likely that client involvement has an important influence on subsequent implementation of a product (Weil 1980). The degree of involvement has differed, but

has found its most distinct expression in Group Model Building, a term created by system dynamicists at SUNY Albany.

The importance of client involvement, both for the modeling process itself, and for the implementation of model results, has led to a number of studies in which Group Model Building may be seen as a common feature (Vennix 1992). Studies have produced detailed descriptions of steps in the group modeling process and the different roles of individual group members (Richardson and Andersen 1995; Andersen and Richardson 1997). Detailed procedures for controlling and directing the modelling process have been described (Randers 1978). The knowledge elicitation process and techniques to support and make the process more efficient have been developed (Ford and Sterman 1998; Vennix 1990). Some studies have focused on the learning process among the participants (Lane 1992), while others have been more interested in how the team discussion could function as a decision support process in management groups (Morecroft 1992). In most cases, the modelling setting has been quite uniform. In the course of several meetings, the client group, together with a facilitator and a modeller create a computer model that utilises several techniques such as a “behaviour over time diagram”, “causal loop diagram”, “graphical function diagram” and “stock and flow diagram”. Different ways of organising and accomplishing group model building have been employed, but with limited variations (Vennix 1996).

In this paper we describe how system dynamics and group model building can be used to speed up and improve the process of developing multiplayer games. We also discuss how game playing itself can be a part of the group modelling process, and thus influence how knowledge is elicited. We also describe how intervention in the group modelling process influences the outcome and the participants' view of the process.

A traditional way of handling game development projects would include the development of a system description from the client, followed by programming and ending up with a final software product to be delivered to the client. Such a process is liable to be rather time-consuming and expensive, but most importantly, in most cases it will create an information gap between the domain experts who hold the knowledge that is to be incorporated into the game, and the game developers. There is also some experience that suggests that this approach in many cases would divert attention from the underlying model structure responsible for creating the game behaviour, over to a interface focus.

We wanted to experiment with an alternative development strategy. Emphasizing the problem related to information collection, we wished to reduce the delay in the feedback loop between expert descriptions, system implementation and expert comments and corrections. At the same time, we were interested in how to increase the ability to gather information about a system with ill-defined relationships, partly based on conflict between opponents. By applying group model building to the development process we hoped not only to increase the efficiency of knowledge elicitation, but also to establish a higher level of expert confidence in the solution that emerged. We also wished to maintain a sharper focus on the underlying game structure than on the game interface. In addition we wanted to include game testing as a part of the group model-building development setting.

Case

Our starting point was a war college which wished to develop a game for decision-making training at a strategic level. The domain was air defence, the topic air power. The client had a clear idea about what to train and how. The challenge was how best to develop a solution that would satisfy the client.

The game was to be at a highly aggregated level, putting the players into typical decision dilemmas. The dilemmas should be a result both of the system's internal structure and the uncertainty created by other players' decisions. The dilemmas in the game should correspond to the accepted domain theory and in this way underline and strengthen players' existing knowledge and stimulate them to engage in theoretical reflection.

A full day was set aside for a modelling workshop with the domain expert group. Armed with a general understanding of the topic based on readings and some hours' discussion in a mixed defence group, the modellers met the expert group. The group was made up of four to six experienced instructors from the college, all of whom had deep insight into air power and related topics.

For their part, the modelling group consisted of an experienced modeller/facilitator and several observers. The domain experts were first given a brief introduction to decision-training games in general and to modelling tools. They were then introduced to the modelling project, and were requested to decide on the model boundary, time units, decisions steps, level of aggregation, etc. Once the work had been framed, the rest of the day was used for modelling. The modelling was based on the experts' understanding of the actual problems, with the principal focus on system structures being the cause of central dilemmas. Traditional tools for the setting were used, such as "causal loop diagrams" and "level and flow diagrams". At the end of the first day of the modelling workshops the expert group was given the choice of which model variables should be player decisions, and the opportunity to offer suggestions about interface design.

On the first evening of the modelling workshop, the model was refined by a small group of modellers and a draft game interface was added. The game, which was designed for a game leader and two teams playing against each other, was then installed on a 3-node LAN.

The following morning, the expert group briefly inspected the model, and were introduced to the draft game interface. They were then divided in two teams, and asked to run a number of games in order to test the behaviour of the model and the game interface and design. On the basis of this experience the modelling group turned back to the model, discussing game behaviour and model design. A number of changes were proposed in both the model itself and the interface.

During the following week the list of changes was implemented and a modified game was submitted to the client for testing. Only a limited number of changes were actually made, leaving unchanged 80-90% of the original structure that had been developed at the first workshop.

As a part of a training and exercise week, where Army and Navy war college students were learning about air defence, the modified game was used as a means of reinforcing students' understanding of air power dilemmas. After an introduction, the students were divided into six teams and allocated to separate rooms. Each pair of teams, unknown to each other, was given a scenario description and would then run the game followed by a debriefing. A number of games were run in this fashion, each of them with a new opposing team.

The game software and the game itself were left on the college computer network, and it turned out a few weeks later that the instructors who had taken part in the model-building process had started using the game as a part of their courses. Coming back afterwards, they not provided feedback on how the game itself had functioned in the training situation, but also ideas for changes in the underlying model. Through the games played by the students, the instructors gained experience about weakness and errors, as well as potential enhancements to the model.

Modelling games

The objective of developing games for decision training in a professional environment is to encourage learning. This is not necessarily a matter of learning directly from the game itself, but may be as much learning as a consequence of reflecting on the totality created by the game, the game scenario, one's own and opposing teams and instructors (Bakken et al. 1992; Isaacs and Senge 1992). Games for professional training need not necessarily have advanced interfaces, as professionals are usually capable of comprehending a situation based on information presented in a simple way. In fact this also reflects the reality for many decision-makers at strategic level, where information is only available in an aggregated, text-oriented manner. The primary functions of the interface are to plot decisions into the system and read information out of it. The most important issue is to make the game deliverer credible behaviour related to basic theory and the assumptions given.

The expectations of a client when starting the development of a game are often concerned with the interface. This was also the situation in our case. Even though the goal had been set well in advance, for a game at a highly aggregated strategic level, quite clear expectations emerged for a detailed game interface with all sorts of 'bells and whistles'. However, modelling the underlying structure altered the mindset within the expert group. Creating a visual representation of the mental models possessed by the participants attracted the full attention of the group. The discussion focused on the domain, and the participants themselves took care not to become too detailed in the description of the system, keeping away from discussions about events and staying firmly with a highly aggregated description. The main issue for the development process became that of which decision dilemmas the group wished to create and how these dilemmas could best be illustrated.

During the modelling session we experienced a change in both the role and the focus of the experts in the modelling group. As the discussion progressed, the experts changed

from a customer-like style of asking for solutions to a more participant role in which they produced solutions on their own and in this way moved their own fields of competence closer to the centre of the development process. These changes in discussion focus were expressed by the way in which the group went from detailed event-oriented thinking to high-level descriptions of a few important structures, just enough to create the decision dilemmas they were looking for.

The pedagogical element in a game developed for training must obviously play a central role. In our case we experienced the conflicts that pedagogical aspects created, with their demand for realism. In terms of realism, information about the situation of the opposing forces (intelligence) should be different from the true situation. This difference might depend on the level of one's own intelligence service in addition to a random function. From a pedagogical point of view this sort of misleading information feedback was not regarded as appropriate. Making the effect of one's own actions less traceable, it would reduce the students' possibilities to reflect over the relationship between action and effect. The behaviour created by a structure dominated by feedback, delay and non-linearity was, from a pedagogical point of view, more than enough to challenge the students' ability to comprehend complexity. When the effects of the opposing players' decision-making was added, the picture for the student was more than complex enough to create challenging decision training. Even though one ended up in

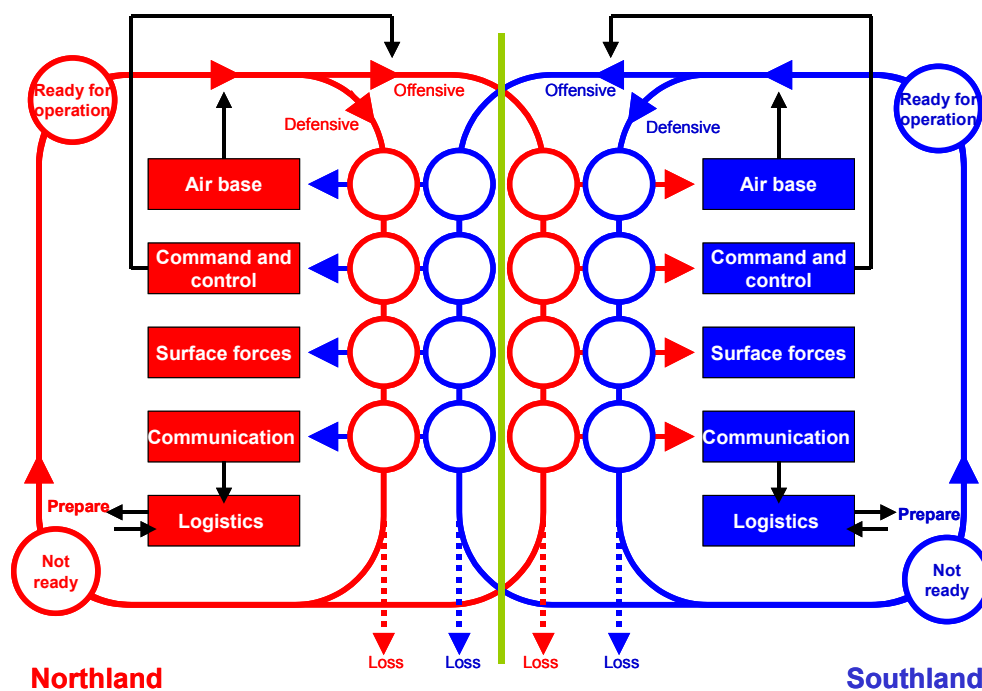


Figure 1: Conceptual model for Air Power Decision Training developed during first day of group model building

this case with “noise” that the instructor could switch on or off, the focus on pedagogical usefulness remained central throughout the project. Rather than a correct and detailed description of a system, it was decided to develop a model that would supply the information needed by students to conceptualise situations that arose,

dilemmas they needed to face, theory they should exploit and decisions they would have to take.

Group model building is a setting tailored for knowledge elicitation. But it is also a setting for knowledge dissemination. Over and over again, the group model building setting enabled us to see how people who have worked side by side for a long time could “update” their perception of each other’s understanding during the modelling process. The combination of qualitative and quantitative system description during the group model building process enforces rich discussions that enabled us to formalise mental models. But it also has the capability to involve and alter the mental models of the participants.

Modelling games – with games

Group model building usually includes a description of reference modes. Somewhere in the modelling process, model runs and the reference mode will be compared. Even for a game group model-building setting it is natural to describe reference modes for certain situations. Running the model in order to compare the reference mode with actual model runs is a little more complicated. To create a run that could be compared with the reference mode it is usually necessary either to model players’ policy or actually to play the game. As the modelling process was aimed from the very beginning at creating a game in which players are responsible for implementing their chosen policy, adding policy elements to the model for testing purposes seems rather pointless. A much more obvious method is to complete the model with a game interface and let domain experts from the modelling group experience the model behaviour by playing.

Most multiplayer games have relatively few variables for player information output and even fewer decision variables for input. This makes it possible to develop a quick and straightforward draft game interface within a reasonable time and with minor consumption of resources. Establishing this sort of sketch game interface opens up a number of possibilities. Testing an unlimited number of runs vis-à-vis reference modes is one; trying out different decision policies is another possibility that can be implemented with little effort.

Having brought the model the short distance to a playable game also opens up a different modelling discussion. Moving back and forth between model and game brings up new and exciting elements in the model development process. One might well say that the game interface gives the group model building setting a “new” tool for discussion and development. This is certainly true of situations in which the model describes systems with multiple stakeholders, and stakeholders in a situation characterize it in terms of competition or conflict. The possibility of playing the game during the modelling session provides an opportunity to learn more about the consequences related to this properties of the system and to move back to the model for corrections and enhancements.

The expert group that took part in our group model-building process had the opportunity to offer their opinions of the modelling process, both in a questionnaire and in open

interviews. They pointed out the process had been quite different from what they had expected. Instead of describing a set of system requirements they ended up in the middle of the development process itself, and experienced how the model and game emerged during the group model-building process. They also expressed satisfaction about how much had been achieved within such a short period of time.

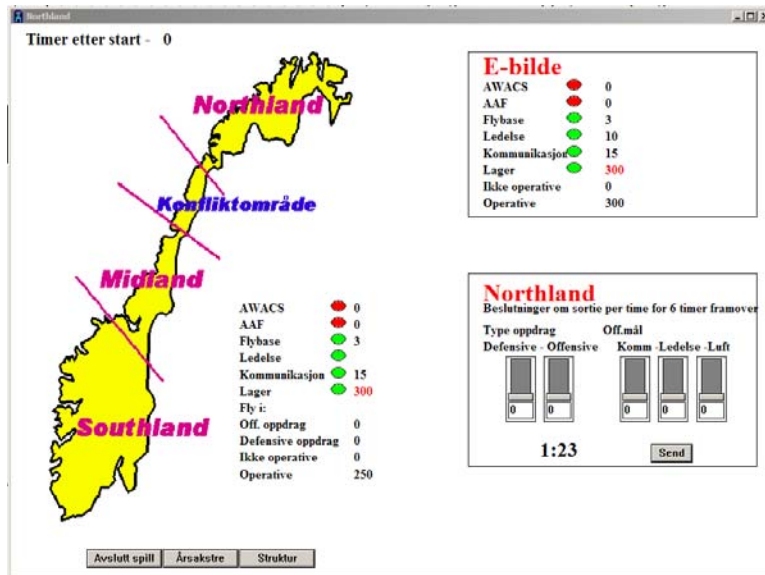


Figure 2: Draft game interface developed during first day of group model building workshop for testing purposes

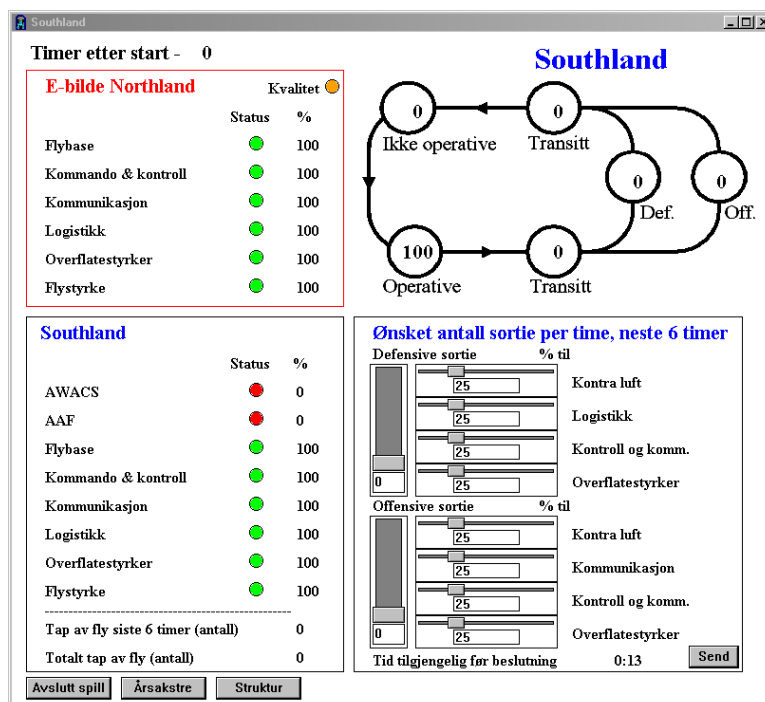


Figure 3: Final game interface for “Air Power Decision Trainer”

The development processes evidently created a sense of ownership of the product among the expert group. This sense of ownership was reflected in a number of ways. Weaknesses and errors in the model were not regarded as a problem for the modeller, but rather as challenges for the expert group and their system knowledge, both during the modelling workshop itself and later. The instructors participating in the expert group immediately began to use the game in their classes and they did internal marketing of the project via-a-vis the rest of the college. Given their detailed knowledge of the underlying model and the user interface, they were able to come up with ideas for enhancements and more comprehensive plans for new versions.

Game use

The game has been used in a number of decision-making training settings in which professionals under training took part. The training sessions were all quite extensive, lasting from one to three days and with a well-defined structure. The teams that played comprised from four to eight persons and the sessions mainly followed a structure that consisted of a scenario briefing, playing the game and a debriefing session. The instructors' evaluations, external observations and feedback from the participants obtained by questionnaire, all give an impression of a successful solution. The instructors in particular pointed to the extensive group processes involved in the training session and emphasized how the game is a tool for triggering group discussions on important domain issues.

We do not underestimate the importance of the development style employed in this project for the success of the application. It is quite natural that a sense of product ownership among the instructors involved would influence how they integrated the game into their training sessions. Insight gained during the development process would be likely to influence confidence in the product and the ability to explain its assumptions and behaviour.

The development process established confidence among the instructors that the game supports important theoretical issues that are emphasised in the college's training programme. Relying on this, from the instructors' point of view there is no drawback in a possible lack of detail in the model. On the contrary, this simplification makes it possible to focus more directly on the training elements that one wishes to emphasise, enabling an "in-depth" focus to be placed on central dilemmas and dynamics in conflicts involving air power

Conclusions

Group model building obviously has certain qualities that make it suitable as a framework for game development. The most striking experience gained from the development process clearly was the very short time involved, from initiation to completion. This was related both to the actual resources employed and to the amount of time put by the participant in to the project from start to the first version of the

product. The main work was compressed into two days, from when the domain experts first met the modelling team until they had already run an early version of the game.

Group model building is an effective way of eliciting knowledge. This experience also applies to situations in which game development is the goal. In traditional game development the development team would take the responsibility to push forward both the interface design and the game behaviour control. With a game software product in mind, the client can easily perceive the interface as the most important part of game development and thereby end up with a focus on design issues. The group model building setting provided a framework for drawing and keeping attention on what should be considered to be the main theme, the model structure.

On the one hand group model building seems to be an efficient tool for game development, ..not only because it offers quick results, but also because the underlying model that creates the game behaviour has a sounder professional foundation when domain experts from the client have taken part in the development process. Group model building also has the strength of creating involvement for the client, which ensures trust and ownership, making implementation of the modelling result more likely.

At the same time, gaming can be regarded as a useful tool in the group model-building process itself. When looking for techniques to develop client involvement and engagement, to improve the facilitators' capability to understand the expert's informal mental models and, in some cases, to bring out the important elements of conflict that are built into many systems, group model building could be a useful tool.

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