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Improving communication in urban planning using TOPIC-COHESIE

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Abstract: Decision making in spatial planning often takes place in a complex and ill-defined context. It includes a large number of actors, factors and –often uncertain– relations. Each of the actors or stakeholders has his or her individual perceptions, values and priorities. This paper presents the TOPIC system, which aims to support this process by interactively collecting and managing the information in a participatory stakeholder process. We focus on a specific version of TOPIC – named COHESIE – which includes functionality for qualitative, participatory modelling. By representing actor perspectives in an explicit and transparent way, the modelling process facilitates the discussion and improves the communication between the different parties. This paper will illustrate the use of TOPIC-COHESIE with a practical example related to urban planning in the Netherlands. The participants of the case study have evaluated TOPIC_COHESIE a useful tool for early stakeholder involvement, and obtaining a more integrated plan.

Keywords: Participatory modelling; Urban planning; Qualitative modelling; Fuzzy Cognitive Maps; Planning Support System.

1. INTRODUCTION

Good communication is crucial in participatory planning processes. Far too often problems arise because stakeholders:

- have their own interpretations of the terminology used;
- have implicit knowledge, which they assume everyone has;
- reason from fundamentally different perspectives;
- lack a shared understanding of the problem and possible solutions;
- have different goals, values and core assumptions; and
- have hidden agendas.

TOPIC (Thematic Orientation of Problem definition in an Interactive Context) has the explicit aim to provide support for interactive planning and decision-making. It improves communication through structuring information, by making implicit knowledge explicit and individual thoughts transparent. Its main focus is on the support of the first phases of the planning process: the development of a well-defined problem definition, a set of objectives, an inventory of possible alternatives and a first assessment of the impact of those alternatives.

This paper focuses on a specific version of TOPIC named COHESIE. TOPIC-COHESIE extends the TOPIC toolbox by including a module for qualitative modelling. It was developed and applied as part of the COHESIE project (ICIS, 2006; ICIS, 2003) supported by the Netherlands Ministry of Housing, Spatial Planning and the Environment (VROM).

We illustrate its application for a case study of city planning in the city of Kerkrade, The Netherlands, in which the system and the accompanying methodology have been used and evaluated. The paper serves as an example of applying participatory qualitative modelling in practice, and aims to illustrate the potential for TOPIC-COHESIE for supporting participatory planning processes. It is to a large extent a summary of the final report of the project (ICIS, 2006).

2. THEORY

2. 1 Participatory modelling

In the application described in this paper use is made of 'participatory modelling' (Van Asselt, 2002), also known as 'group model building' (Vennix, 1996). In this approach model users are actively participating in the model development process.

The main objective of participatory modelling is to provide insight in:

- The system: Because of the inherent complexity of the real-world system, most participants have difficulties to oversee the whole system in which they are operating; relevant (weak and strong) relations, possible feedback loops and sight-effects of actions are often unclear. The aim of the modelling session is to create a mutual understanding about the real-world system. The wide input of stakeholders can very well be used to include different elements of this system.
- Each other's opinions: Participatory modelling facilitates a structured dialogue between stakeholders. The process contributes to an improved understanding of each others objectives, problems, position and perception and stimulates trust amongst the participants. In doing so it can help to reach consensus within the group and can play a significant role in the process of social learning (Ridder, 2005).

Modelling in general, and participatory modelling in particular, encompasses objective and subjective elements. Through participatory modelling, subjectiveness is made explicit since the different perspectives of the participants form the basis of the model. Moreover, uncertainties and differences in opinions become apparent.

In a participatory modelling process different types of models can be used, ranging from conceptual to quantitative. The approach used in TOPIC-COHESIE lies in between those two extremes and can be expressed as qualitative modelling. This technique combines the advantages of transparency and 'soft' elements in conceptual modelling with the possibility to carry out what-if analyses as is normally done in quantitative modelling.

2. 2 Qualitative modelling

The methodology for qualitative modelling in TOPIC-COHESIE is based on the concept of Cognitive Mapping (Axelrod, 1976). A cognitive map is a graphical representation of (the interpretation of) a system and an example of a conceptual model. System variables are represented as boxes; relations between variables are represented by arrows. The term 'cognitive' is used to indicate that the 'map' represents the cognitive interpretation of the system. This can be an interpretation of a scientist, a stakeholder or a policy-maker. Despite of a certain degree of compatibility, the interpretations of complex systems will generally differ from each other at essential points. This should not be seen as a weakness of the approach, it rather is its strength to make those differences explicit.

Fuzzy Cognitive Mapping (Kosko, 1986) is an extension to Cognitive Mapping that allows to qualitatively calculate the impacts of changes in the system. The term 'Fuzzy' is used because the value of the variables is neither numeric nor exact, rather it is interpreted in a linguistic way. The state of a variable is therefore not expressed in absolute values, but is provided in an ordinal scale. In TOPIC-COHESIE, the safety of a neighbourhood is, for example, represented on a scale of seven classes, ranging from 'very safe' (+3), via 'neutral' or 'average' (0), to 'very unsafe' (-3). The strength of the causal relations between

the variables is expressed on the same ordinal scale from 'very positive' (+3), via 'slightly positive' (+1) and 'slightly negative (-1) to 'very negative' (-3).

The traditional Fuzzy Cognitive Mapping methodology only uses causal relations. In practice, however, other relations can be important as well. The housing corporation could, for example, indicate that they will support the plan if there is a minimum number of new housing units being developed. This statement then takes the form of a threshold. To model these relations TOPIC-COHESIE is equipped with an 'if-then' feature (ICIS, 2006). This feature is in line with the concept of Rule Based FCM (Carvalho, 2000).

3. TOPIC-COHESIE

3. 1 The system

TOPIC-COHESIE is a software instrument developed to support participatory, qualitative modelling. It can be used in every interactive policy-making process, decision-making process, planning process or management case with multiple stakeholders. The domain and context of a new case can be set-up easily and can be adapted at any time. The information gathered in discussions with stakeholders (during interviews and workshops) can be stored, ordered, accessed and displayed easily. Moreover, it can be linked by making use of relations. Besides textual information, also other data like documents, drawings, photos and media recordings can be added as information. Structuring the information in this way leads to more insight in the implicit knowledge of stakeholders, deepens the level of information and facilitates a common understanding of the definitions and terminology used.

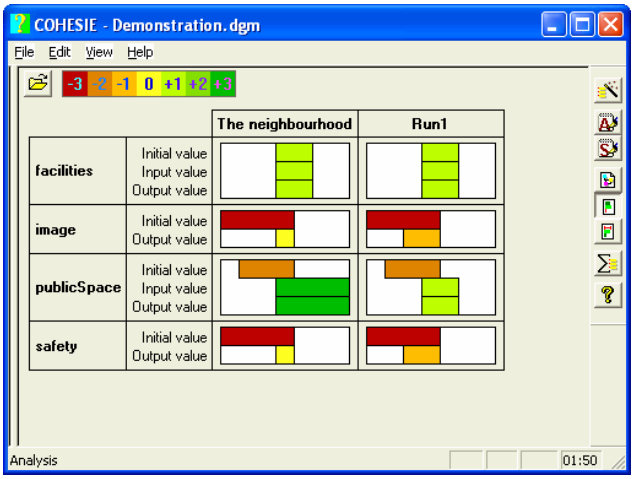

Figure 1. Comparison functionality in TOPIC-COHESIE: the screenshot shows the results of two alternatives -the neighbourhood and run 1- on the indicators facilities, image, public space and safety.

Besides storing and accessing the information in a textual way, it can also be represented in a graphical, conceptual model. Based on this conceptual model, simple qualitative calculations can be made. Stepping through the results of the calculations the stakeholders can see the first, secondary and higher order effects of proposed measures and compare the impacts of different alternatives. From this graphical model, the stored textual information can be accessed and adapted. Furthermore, the perception of different stakeholders towards various alternatives can be visualised. As an extension to the qualitative calculations, an optimization algorithm, a visual comparison module and a sensitivity analysis module are available. The system is complemented with a reporting functionality for quick generation of custom designed reports from the entered information, ready for further editing in word processors.

Although the system is developed for policy-makers and decision-makers at local, regional, and national administrations, also (project) managers, researchers and modellers can benefit from the functionalities of the system. It can be used to provide support in different phases

of the decision-making process, but –because of its systemic approach and focus on causal relations– also as a starting point for the development of quantitative integrated models. More information about the TOPIC-COHESIE system can be found in RIKS (2006). RIKS is also the contact point for any inquiries about the system.

3.2 Modelling city planning with TOPIC-COHESIE

For TOPIC-COHESIE we have developed a standard model for neighbourhoods (ICIS, 2003; ICIS, 2005). This model was developed using expert interviews and experience from previous case studies. It is used as a template when developing specific applications.

The standard model consists of two parts: the physical neighbourhood model and the actor model. The model for the physical neighbourhood includes the main elements that have an impact on the image of the neighbourhood such as: the participation of inhabitants, the fraction rental houses, the safety on the streets, the amount of public space, the availability of facilities, the prices of rental and private properties and the number of vacant houses. In the actor model we have included the various elements that a stakeholder takes into account before giving his or her approval to a plan: the extent to which the plan meets the objectives, its costs and the trust of the stakeholder towards the process and the other stakeholders.

The model development process follows the following procedure: First, the standard neighbourhood model is used as a starting point. Next, we make an inventory of the actors involved and their objectives. Then, we investigate how the neighbourhood system functions, based on the perceptions of the different stakeholders. We discuss with the stakeholders what measures and alternatives can be proposed as part of the plans for restructuring the neighbourhood as well as the costs for each of the stakeholders associated with these measures. Finally, we investigate what is important for the different actors to agree to a measure. Based on all the information above a case specific model can be developed. This model can be fine-tuned by running model simulations and by further interaction with stakeholders.

4. PRACTICAL APPLICATION

Dohmenplein is a neighbourhood in the municipality of Kerkrade in the Netherlands. Although the neighbourhood was characterised as a pleasant living environment a few decades ago, it now experiences problems: a poor living quality, bad image, low quality housing and limited social coherence between residents. Recently, the housing corporation has taken the initiative to revitalise the neighbourhood. It thereby aims to establish broad support for the revitalisation plan amongst the stakeholders involved. In this context, the specific aim of the case study described here was to reach a common view on the problem and its solutions among the key stakeholder group: the housing corporation, the city of Kerkrade and the association of inhabitants.

4. 1 Process

The process followed for participatory modelling with TOPIC-COHESIE is presented in Figure 2. The design of this process is derived from an existing methodology developed by Vennix (1996). The elements in bold (problem definition, interviews, analysis and model development and workshop) are part of the process. The other elements (individual models, joint model, conclusions and evaluation) are results of the process.

The methodology starts with individual interviews and participatory modelling (mapping diversity, diverging), followed by a common stakeholder workshop to bring views together in an integrated assessment, and to reach consensus (consensus building, converging). This set up has the following advantages (see also Vennix, 1996):

- Mapping diversity: In personal interviews a stakeholder can express his or her views without being influenced by the other parties;

- Getting acquainted with the methodology: During the interview session stakeholders became familiar with the system and the process of model development;
- Preparing input for the workshop: The models developed during the individual sessions are valuable input for the workshop.

We carried out two individual interviews per stakeholder. In the first interview (~ 2 hours) we presented a short questionnaire to collect the main objectives, problems and social network relations. Furthermore, the interview contained an interactive modelling session which was used as a first step to develop the individual model. The first interview provided a wealth of information that was processed as part of the analysis and model development phase and resulted in a first version of the individual models. In a second interview (~ 1 hour) this model was brought back to the stakeholder with the aim to ensure that the stakeholder maintains ownership of his model and to reflect on the model, make final changes, ask for definitions of variables included and discuss if-then relations. After the second session the models formed a representation of the perception of the individual stakeholders. They were also perceived by the stakeholders in this way.

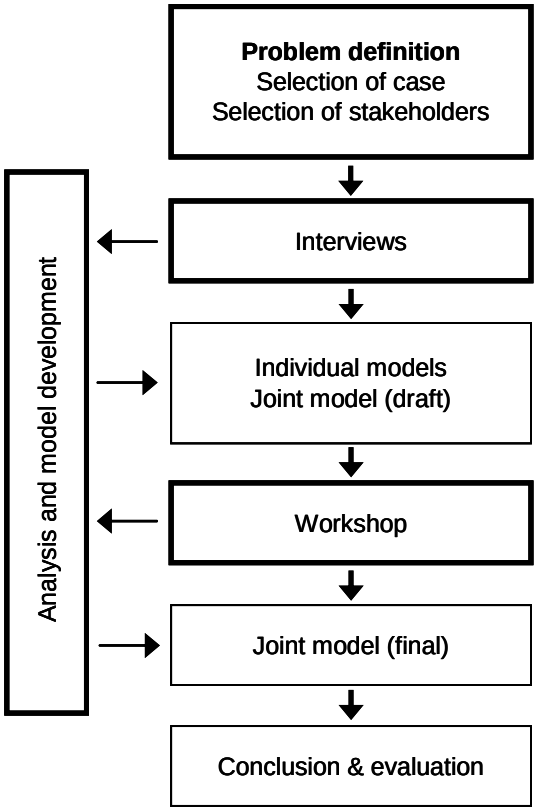

Figure 2. Methodology for participatory modelling with TOPIC-COHESIE.

At the final workshop all representatives of the stakeholders were present. During this workshop the three separate models, developed by the individual stakeholders, were presented, resulting to an improved understanding of each others perceptions. Subsequently an integrated model was presented based on the communalities. Moreover, bottlenecks were defined and discussed. Through the discussion some conflicts were resolved and for others the impact on the overall system was made explicit. At the end of the workshop a model was developed that included all elements relevant to the problem at hand as well as their causal relations. With this final model different alternatives for restructuring the neighbourhood can be assessed on a common platform agreed upon by all stakeholders.

4. 2 Results

In this section we describe the most important results of the case study: the *models* including the three individual models and the joint model as presented in figure 3, an integrated *problem analysis* including agreements and fundamental disagreements (‘bottlenecks) amongst the stakeholders involved, and the *social relational results* of the modelling process.

Models

The individual models are a clear reflection of the perspective of the respective stakeholders. In the model of the municipality, for example, the revitalisation process is

seen in the larger picture of the development of the city. Besides general objectives of quality, affordability and image, the municipality also aims for a lower housing density and puts the focus on age appropriate housing.
The housing corporation has to ensure that new plans fit within her mission as well as her business perspective and financial constraints. Regarding the first, the quality and affordability of the housing stock together with the quality of life are seen as important objectives. To obtain the necessary financial benefits it is important to have a low vacancy rate and a good rental price. In the ideal plan of the corporation there will be a balance between social housing and houses in the private sector.
The perspective of the inhabitant is that of quality of life and affordability. In this model two aspects become apparent. First of all it points out the problem of public nuisance: trash on the streets, noise pollution and gatherings of teen-age groups. Secondly the inhabitant is the only actor that has included trust in its final approval of a plan. At present, trust is low, because of the long duration of the process and the poor communication of this duration. The corporation and the municipality were not aware about the inhabitants' feelings and this was a learning point during the case study.
The objectives of the different stakeholders are summarized in table 1.

Table 1: Objectives of the stakeholders.

	Corporation	**Municipality**	**Inhabitant**
Quality of the housing stock	+	+	+
Affordability	+	+	+
Image	+	+	+
Quality of the public space		+	
Age appropriate housing		+	
Housing density		-	
Vacancy rate	-		
Rental price	+		

Based on the agreements between the models of the different stakeholders a first joint model was developed and presented during the workshop. Using this as a starting point, differences in terminology and points of view were discussed and in an interactive process the model was gradually expanded to its final version (see Figure 3). This version, however, does not yet present a complete consensus between the stakeholders. Although there is agreement on the variables and relations, the relative weight and strength of the relations is not always the same. An example of this is the image of the neighbourhood, which is dependent on the visual appearance, the quality of life and the affordability. The stakeholders agree on these components but give a different weight to the relative importance of these elements.

Problem analysis
The modelling process conducted so far served to clarify, both agreements and fundamental disagreements amongst the stakeholders. It became clear, for example, that all stakeholders shared the opinion that the main focus areas should be housing quality, affordability and image. There is also consensus about the statement that 1) the quality of the housing stock has to improve, to improve the image of the neighbourhood, and 2) a balance has to be found between the prices of the rental properties and the quality, to ensure the affordability of the houses.

Bottlenecks that became clear during the workshop discussions were:

- Mission versus business perspective: The housing corporation in general experiences a tension between her mission (building according to needs of social housing and cheap private housing) and her business perspective. Housing development solely in the social sector does not provide sufficient financial benefits.
- Reducing the housing stock: The first bottleneck is exacerbated by the desired reduction of the housing stock caused by the expected population decline. Reducing the housing stock has negative impacts on the financial benefits for the housing corporation.

- Insufficient insight in the housing needs: Although both the corporation and the municipality value a differentiated population, a clear definition of the target group is missing.
- Lack of trust: the low level of trust of the inhabitant forms a bottleneck in the redevelopment process. According to the inhabitant this problem has occurred because of the long duration of the process. The other stakeholders realise this and will strive to improve the communication about the duration of these types of processes.
- Improvement of public space: While the municipality saw a solution in placing lampposts and benches, the inhabitant agued that this would attract nuisance by teen-age youth and thus aggravate the feeling of unsafety.

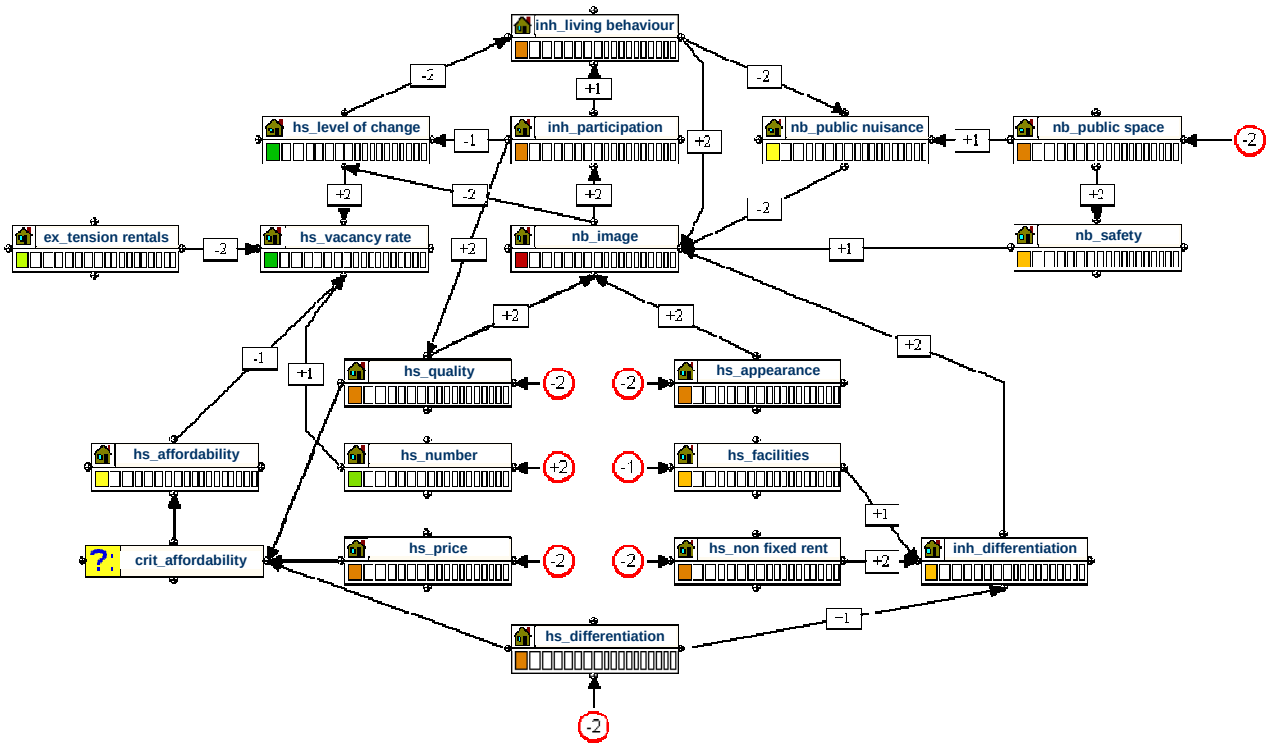

Figure 3. The joint model of the neighbourhood and its processes, agreed upon by all stakeholders. Variables are grouped into those linked to the housing stock (hs), the inhabitants (inh), the neighbourhood (nb) and exogenous (ext).

Social relational results

The participatory process in the case Dohmenplein has been too short to expect major social relational results. However, we would like to describe some initial findings:

- Improved understanding of the core problems: With the support of TOPIC-COHESIE it was possible to present individual perspectives in a transparent manner. Based on this, the main bottlenecks could be identified.
- Changes in perspective: In our opinion, a better understanding of the problems has not –yet– lead to a change in perspectives. In a more elaborate process this could however be an important result.
- Relations and trust: the open and transparent discussion seems to have contributed to improved relations and trust between the stakeholders.

5. CONCLUSION

At the end of the workshop, the participants engaged in an open discussion to evaluate the TOPIC-COHESIE approach. Overall, this evaluation was positive. They see the tool as a useful instrument to include stakeholders in an early stage of the planning process, start the

communication between the stakeholders in an efficient manner and –as a result– obtain an integrated plan. In particular, the graphical modelling functionality –defining variables, providing definitions, creating relations– has proven to be an added value. The bilateral development of the model, as a joint effort of the stakeholder and the modeller is a good step to obtain insight in the position and objectives of the individual stakeholders and brings stakeholders closer together. The workshop session in which the individual models were discussed led to an improved understanding of each others position and objectives.

Critical notes have also been made. According to the stakeholders the tool is too abstract, which might lead to misunderstanding instead of transparency, especially when using it with inhabitants. Secondly, the qualitative calculations have to be interpreted with care. Especially for complex case studies involving a high number of variables, it takes time and knowledge to develop a consistent model in TOPIC-COHESIE. Interactive model building and model explorations during a participatory modelling session can therefore be problematic. The development of illustrative sub-models might be a good way forward in improving the consistency of the qualitative computational models. Third, the TOPIC-COHESIE approach does depend on stakeholders that are willing to cooperate in a transparent and open dialogue. Stakeholders with serious 'hidden agendas' are most probably not eager to participate.

Overall, the use of TOPIC-COHESIE in a participatory setting has been successful. Even though it will never be able to solve all communication problems mentioned in section 1, it has shown its added value as a tool that improves the communication. TOPIC-COHESIE increases the *efficiency* of the communication process (by coming directly 'to the point'), the *transparency* (because the models reveal the actual perceptions and objectives), stimulates *reflection* (because the participants reflect on their own perceptions), supports reaching *consensus* (by creating a common understanding of the system, making each others perceptions and aims explicit, creating trust and stimulating an open discussion) and is useful for the *documentation* of the individual perceptions and objectives as well as the shared understanding of the system. To further develop the tool and the methodology, it is recommended to carry out more practical exercises to experience what users find difficult or inconvenient and to discuss if and how those problems can be solved.

REFERENCES

Axelrod, R., Structure of Decision, Princeton, Princeton University Press, 1976.

Carvalho, J.P., Tome, J.A.B., Rule based fuzzy cognitive maps-qualitative systems dynamics. This paper appears in: Fuzzy Information Processing Society, 2000. NAFIPS. 19th International Conference of the North American.

ICIS, COHESIE: **CO**mmunicatie-instrument **HE**rstructurering **S**teden in een *I*nteractieve **C**ontext. ICIS, Maastricht University, Netherlands, 2003 (www.icis.unimaas.nl).

ICIS, Tussenrapportage COHESIE II. Handelingsmotieven: input voor een gedragsmodel. ICIS, Maastricht University, Netherlands, 2005 (www.icis.unimaas.nl).

ICIS, Eindrapportage COHESIE II: **CO**mmunicatie-instrument **HE**rstructurering **S**teden in een *I*nteractieve **C**ontext. ICIS, Maastricht University, Netherlands, 2006 (www.icis.unimaas.nl).

Kosko, B., Fuzzy Cognitive Maps, In: International Journal of man-Machine Studies 24 (1), 1986.

Ridder, D., E. Mostert, and H.A. Wolters (Eds.), Learning together to manage together, Osnabrück, Germany, University of Osnabrück, 2005.

RIKS, User manual for COHESIE 2, RIKS bv, Maastricht, 2006. (www.riks.nl/projects/cohesie)

Van Asselt, M. B. A. and N. Rijkens-Klomp, A Look in the Mirror: Reflection on participation in Integrated Assessment from a methodological perspective, Global Environmental Change vol. 12: 167-184, 2002.

Vennix, J., Group Model Building: Facilitating team learning using system dynamics, Chichester, England, John Wiley & Sons Ltd, 1996.