Group model-building to facilitate organizational change: an exploratory study

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An important objective of most system dynamics modeling projects is to support strategic decision making. This paper describes a (qualitative) modeling project where the primary goal was to establish consensus regarding the problem situation and commitment to the action necessary for change. The project was conducted with a group of mid-level managers of a company at the beginning of a period of organizational change. This group of managers engaged in a series of group model-building sessions, facilitated by the authors. Extensive evaluation of the project results indicates that consensus and commitment with regard to the problem have been established, but that the project was not successful in creating a full consensus on the course of action.

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Over recent decades system dynamics has evolved as a well accepted method to support strategic decision making and strategic change in organizations. The primary goal of a system dynamics model is to enhance understanding of the system's behavior and to find robust policies to tackle strategic problems (Forrester 1961; Richardson and Pugh 1981). However, strategic decisions can have a profound impact on the organization. Even thorough analysis is insufficient for such a decision to become fully implemented. It is necessary that the main stakeholders, in particular managers, are prepared to back up the strategy. In other words, the primary objective in strategic decision making is frequently not to find a robust policy, but rather to encourage team learning, to foster consensus and to create commitment to the resulting decision, in particular when divergent opinions are involved (Checkland and Scholes 1990; Eden 1992; Rosenhead 1989; Vennix 1994; De Geus 1988; Winch 1993).

This paper describes a case in which the initial goal was to apply system dynamics group model building to create a platform for strategic change and to build consensus and commitment (see also Akkermans, Vennix and Rouwette 1993; Akkermans 1995). The client, which for reasons of confidentiality will be called ABC Systems, was a multinational company in the service business. In the past the company had been very successful in a particular market, in what we will call its "old business", primarily a locally oriented market. This success could partly be attributed to the company's particular organizational structure. Traditionally, this structure had been a decentralized one, with highly autonomous business units operating on a regional basis. The management style in these business units (BU) was entrepreneurial and was perhaps best typified as "healthy egotism." In this structure, each BU tried to serve its own particular market as best as it could. This structure had provided the company with a highly flexible and dedicated workforce close to the customer base. This clearly was an asset for the "old business."

However, the market appeared to be changing. A trend could be distinguished toward what we will call the "new business." The most obvious difference from the old market was the increasing international orientation. The autonomous organizational structure seemed less well suited to serving the international market optimally. In the "new business" units would need to collaborate closely if the company as a whole were to remain competitive. Clearly the ruling attitude of most BU management teams would have to change from one of "healthy egotism" into a more collaborative attitude. But how could this be achieved, particularly as the existing attitude had been carefully created and nurtured by top management over a number of years. At

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the request of the company's top management, a pilot study was conducted by the authors with a group of BU managers. The primary goal of the pilot study was to evaluate whether group model building is capable of inducing, in a time efficient manner, the kind of strategic learning and change in management attitude and behaviour that top management considered necessary for the company's survival. In order to avoid any misunderstanding, the project team took as its assignment conducting a couple of group model-building sessions to clarify the problem of survival. This did not mean that they had to manipulate the managers into collaboration; if a more co-operative attitude was to result, it had to be produced by the managers as a consequence of the insights generated during the group model-building process. In the next section we will describe in more detail, the group model-building process with the ABC Systems' managers.

Group model-building with the ABC Systems' managers

Techniques and participants

Over the past few years an emerging trend in the system dynamics community has been to employ a mixture of system dynamics modeling techniques, brainstorming tools and process facilitation insights to foster strategic learning and change (Kim 1990; Kreutzer 1992; Lane 1994; Senge 1990). A subset of the techniques used in this case study is shown in Table 1. As one can see, some of these techniques stem directly from the field of system dynamics (for example, Kim 1990; Morecroft and Sterman 1994; Senge 1990; Vennix 1990). Others originate from such areas as organizational development and operations strategy.

Five managers from different business units within a particular geographical region were selected to participate in the model-building process. In this region, several disputes over collaboration had occurred in the recent past. Before the sessions preparatory interviews were conducted with the managers involved in the project. Initially, two sessions were planned to find out if participative modeling would be able to foster team learning and a change in attitudes and behaviour. After these two sessions results were reported back to top management and process results were evaluated. ABC's top management felt that the group model-building process had been successful in inducing team learning, but that it had not come up with tangible solutions to the problem. Three additional sessions were planned for this purpose. In total, five sessions of two hours each were conducted. Between each session a workbook was constructed and sent to the participants.

University. His research centers on changes in attitudes as a result of participation in group model building.

The project team consisted of the three authors. Each project team member had a particular role in the sessions (see Richardson *et al.* 1995). The "process coach" facilitated the group and monitored group dynamics. The "model coach" focused on the models that were being produced and completed most of the analysis. The "recorder" registered what happened during the sessions and took care of the questionnaires and evaluation interviews. The model-building process went through the following phases.

Preparatory interviews: more consensus than expected

The preparatory interviews were recorded using a "mind mapping" technique (Eden 1989). Two results of these interviews are particularly worth mentioning: the first was a relatively low awareness of the urgency of the collaboration problem, the second was a surprisingly high level of consensus regarding the main causes of the lack of collaboration. Although these managers did not perceive co-operation as an urgent matter, they seemed to agree considerably in their analysis of why in practice collaboration did not occur.

Session 1: explanations for company growth

The authors chose to start the project by modeling ABC Systems' growth in the past, for two reasons. This way of starting enabled participants to discuss the issue of survival as openly as possible, without their being manipulated into collaboration by the facilitators. The second reason was that the project team felt that many of the interviewees' explanations for the lack of collaboration had their roots in the way in which the company had operated in the past and the way it had been organized.

On the spot a causal diagram (Figure 1) was created by the group that explained the company's rapid growth and success in the past decades. To a

Table 1. Techniques employed in the case study for structuring both process and problem

Techniques employed for structuring the process	Techniques employed for structuring the problem
Semi-structured interviews	Mind mapping
Nominal group technique (NGT)	Hexagon brainstorming
Inter-session workbooks	Causal diagrams
Questionnaires	Behaviour-over-time diagrams
Evaluation interviews	Systems archetypes
	Strategic-fit matrices
	Propositions

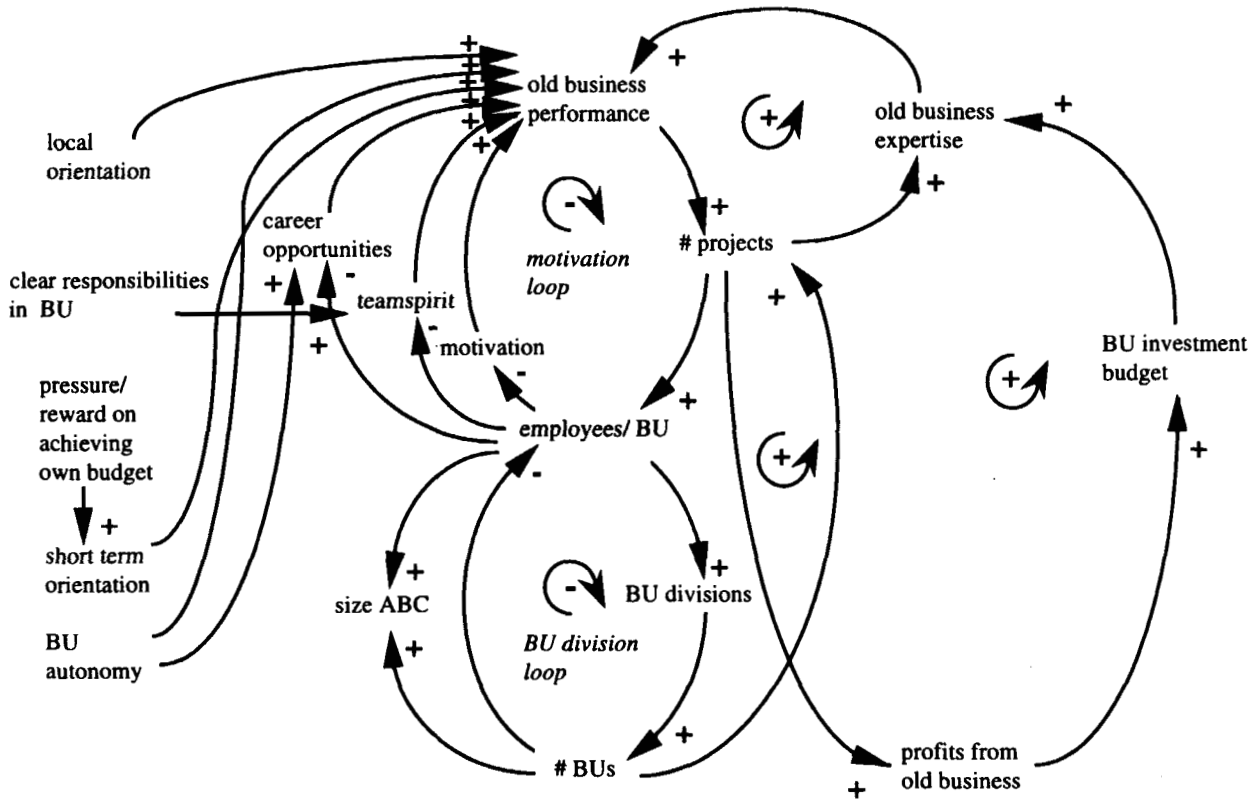

Fig. 1. ABC Systems BU division philosophy leading to effective market performance

large extent, this growth was considered to be the result of the company's highly decentralized organizational structure.

ABC Systems' philosophy is to split up a BU if it has more than a certain number of employees. In a situation of sustained growth of the company (which had been the case in the past) this increases the number of business units, and results in a stabilizing ("BU division") loop. Small units are effective in generating projects in the "old business", because they create a highly motivated workforce, foster team spirit and boost career opportunities. More projects result in more people being employed, thus closing the second ("motivation") negative loop, which in turn sets the first loop in motion (more employees leading to more divisions). Two additional positive loops also result in better market performance. One loop involves the number of projects, resulting in more expertise and better market performance, which in turn leads to more projects. The profits that result from projects also provide a budget, which can be used to increase employees' expertise, business performance and again the number of projects. Apart from business unit divisions,

ABC Systems' philosophy provides for other factors which increase performance in the "old business." Clear responsibilities in business units, a local orientation, a reward for achieving budgets, and business units' autonomy form an integral part of this philosophy. Clear responsibilities have a positive effect on team spirit and a local orientation fits with the locally oriented "old business." The philosophy's reward for achieving annual budgets motivates management to increase short-term profits through higher performance. Every unit's autonomy provides excellent career opportunities. The participants considered the above loops to have been the main forces behind the fast growth of ABC Systems in the past.

Session 2: collaboration and the limits to growth

In the second session the limits to that very same growth were modeled as well. From Figure 2 it appears that the number of business units is not unlimited, but necessarily confined by the size of the demand for "old business". As for the new market, it was striking to see that the BU division philosophy that had produced rapid growth for the company in the past was apparently now working against future growth in the "new business." This even led to competition among business units entering the same market area (Morecroft *et al.* 1995).

Figure 2 reveals that ABC Systems' philosophy is much less suited for the "new business." A local orientation (upper left-hand corner) decreases performance in the internationally oriented new market. Another feature of ABC Systems' philosophy, the orientation towards short term-profits (third variable on the left-hand side) has a negative influence on co-operation because multiple-unit projects usually do not result in gains within the budget period. In the centre of Figure 2 we see that the acquaintance among managers, necessary for creating a willingness to co-operate, declines because of an increasing number of business units. Profits from "old business" (lower left corner) are used for building new expertise, but BU autonomy and budget pressures keep investment very low. The autonomy of business units also prevents ABC from further developing a "new business" infrastructure. All of this results in low performance in the new market.

In Figure 2 two archetypes (Senge 1990) can be identified. The limiting condition "demand for old business" slows the expansion in the "old business," making ABC Systems' limits to growth clearly visible. In addition to this, the success of the "old business" suggests allocation of resources (financial and managerial) to this market. The performance in the new market thus seems to suffer from the "success to the successful" archetype.

It seems that "willingness to co-operate" is a central variable to entering the

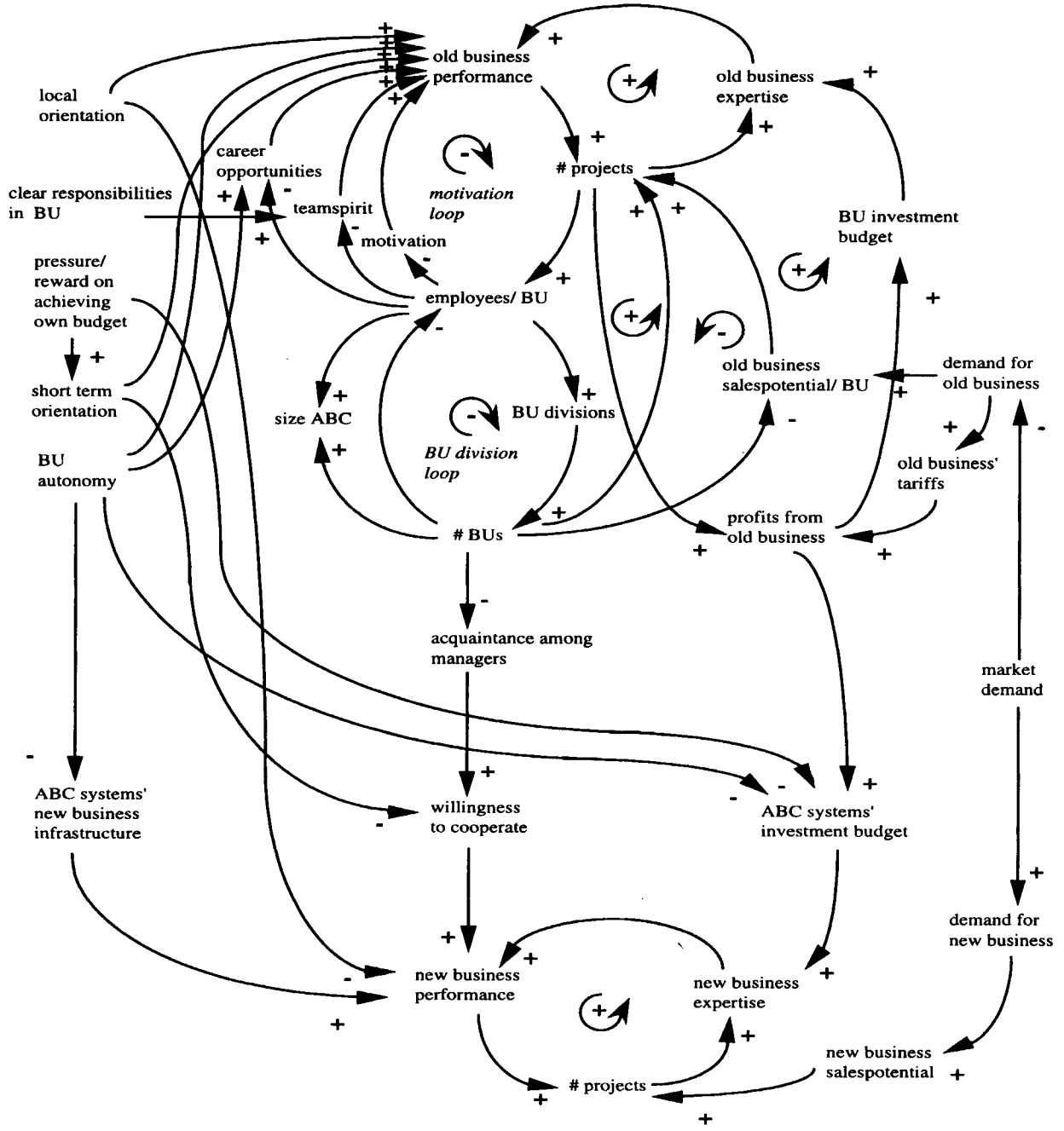

Fig. 2. ABC Systems' BU division philosophy leading to limits to growth in the old business and low new business performance

new market, as it is the foremost influence on new business performance within the control of BU managers themselves. However, co-operation was merely mentioned in this session and the participants did not yet attach significant importance to this variable.

Intermediate reporting to top management

As mentioned before, after the second session (originally intended to be the final session) an intermediate report was produced for top management. In this report a number of conclusions and process results obtained so far were fed back. As far as conclusions were concerned, the causal diagrams that had been constructed during the sessions were explained step by step.

As it turned out, this intermediate report had a considerable impact on the company as a whole. Several extra copies were requested, including a set of copies for all top managers. People throughout the company felt that the essence of the problem was well captured in the analysis. As stated, however, top management held the opinion that no tangible solutions were produced and urged us to plan a couple of additional sessions.

Session 3: changes in the market and collaboration

In the third session the project team wanted to take a closer look at factors mentioned earlier on as reducing the "willingness to co-operate." The group members, however, objected. What they wanted to know was why collaboration was presented as a goal in itself. This then became the focus of the discussion. During the session it became clear why collaboration was essential. More and more the market was asking for products that could only be delivered by collaboration between business units. Although discussed in the second session, it was only in this third session that the full importance of collaboration became clear. The new market was rapidly becoming more important relative to the "old business."

Session 4: market characteristics and organization fit

In the fourth session the characteristics of this new market were explored. In particular, the group looked at the kinds of demands that "new business" placed upon the company's organization. In matrices, differences in characteristics between "old business" and "new business" were recorded. Table 2 gives an example of such a matrix.[1] The participants were of the opinion that, apparently, the original decentralized structure was still the ideal structure for the "old business," which would probably remain the primary income source

Table 2. Selected differences between market characteristics and organizational requirements for two types of business

Market characteristics	"Old business"	"New business"
Duration of ordering process	Short	Long
Average order size	Small	Large
Customer–supplier relationship	Business-like	Co-makership-like
Decision making level	Mid-level	Top-level
Number of competitors	Large	Small
Organizational requirements		
Investment level	Low	High
Skills sales management	Medium	Senior
Number of business units involved	One	Several
Short-term flexibility required	High	Low
Geographical orientation	Local	International

for the company for several years to come. The group concluded that it was for the "new business" that changes to the current organizational structure might be required.

Session 5: recapitulation and solutions

The final session was to serve as a consolidation of the findings so far. The project team felt that, by now, many statements had been made by the group that would be hard to capture in a diagram. The team therefore decided to present the managers with a number of propositions that partly would summarize the discussions so far and partly would feed the discussion in this last session. From the 42 propositions that were presented, only six gave cause for disagreements within the group. It was around these few disputed propositions that the final session centered. However, in the end, the group could not reach a consensus regarding which changes should actually be implemented in the organizational structure. It was felt that all changes basically meant giving up ABC Systems' unique BU division policy, which was at the base of the organization's culture.

Evaluation: organizational change impact

In the first section of this paper we have indicated that one of the primary goals of the project was to evaluate whether group model building would be capable of fostering team learning and changing managers' attitudes and behavior.

In order to capture the potential effects of the model-building project a variety of evaluation materials were used:

- Pre- and post-questionnaires that the participants filled out at the start and at the end of the project. These asked about the causes of and solutions for insufficient collaboration between units.
- A more elaborate questionnaire directly aimed at measuring insight, the quality of the communication, consensus and commitment (Vennix *et al.* 1993). This questionnaire was filled out by the participants after the second and after the fifth sessions.
- Semi-structured evaluation interviews with the participants at the end of the project.
- A post-project analysis of the minutes of the sessions, workbooks and interviews.

In the following sections we will discuss the most important results of this evaluation.

Learning and changing insights

It seems safe to conclude that the managers in this project gained considerable insight into the problem. Indeed, in both questionnaires, all participants stated that they had gained (much) more insight into the problem. The process was effective in revealing relationships between problem elements (four out of five people (strongly) agreed on both questionnaires), and participants' knowledge about feedback processes slightly increased during the project. However, the sessions did not so much create new insights. In line with the lack of new insights, participants did not feel their opinions had changed much (one participant agreed and two (strongly) disagreed that their opinions had changed in the first questionnaire, while the reverse was true after the last session). We can conclude that the project fostered team learning in the sense that it revealed insight into relations between problem elements.

The first sessions seem to have been more successful in exposing the causes and solutions of the problem than the three following sessions. All participants in the first two sessions (strongly) agreed that the project revealed the causes underlying the problem, whereas after the fifth session two persons agreed and one disagreed with this statement. The first part of the project seems also to have created more understanding of potential consequences of the problem than the second part. After the second session four participants felt they understood better the consequences of the problem for the company. At the end two persons indicated the project had created better understanding of the potential consequences while one manager disagreed with this. The potential courses of action with regard to the problem were (much) more obvious for four participants in the first two sessions, but less so after the last session.

When it comes to opinions on the issue of co-operation between business units, we find that at the outset of the project several ABC managers indicated that they did not think that inter-BU collaboration was really a problem to them. It might be a problem for other business units, but they had not encountered it often. This perception certainly changed over the course of the project. Some selected remarks from managers were:

- (In session 3, when asked why collaboration was important:) "Why? Because else we will be bankrupt in a couple of years."
- (After the project, when asked what the best characteristic of the project had been): "Becoming convinced of a new future. In short: the problem exists," and "This subject is a critical success factor for the whole company."
- (At the end of the project, when asked what the main benefits were to him as a manager): "I now have a different view on collaboration. I will now search more for collaboration. If that does not happen the company will go down."

Thus the project seems to have been successful in establishing a more positive attitude toward co-operation.

Quality of communication

When it comes to openness of the discussions, the questionnaire revealed that all participants but one (strongly) agreed that all sessions provided an equal opportunity to engage in discussion. This opinion is confirmed by the results of the interviews. As a couple of managers indicated:

- "Without this method people would not have let the other one finish speaking."
- "In all sessions there was an openness that is not 'normal' within our company. I had the strong impression that it was felt to be a common problem. Everyone went along, there were no hidden agendas."

As a result, participants felt that there had been ample opportunity to share mental models. All participants (strongly) agreed on both questionnaires (i.e. after the second and fifth sessions) that the sessions aided in explaining their ideas to others, assisted in understanding the opinions of other participants, clarified communication and gave insight into the opinions of other participants.

When it comes to the question whether sessions were structured, results indicate that in the managers' opinion structure waned over the sessions. From the results of the questionnaire and the post-project interviews, we can conclude that, overall, participants were satisfied with the degree of structure

in the sessions. The problem formulation at the start of the project was perceived as too vague, but the models, facilitators and workbooks kept the discussion focused. Some participants indicated that in the last sessions the discussions were more frequently diverted and the same themes seemed to resurface several times. Probably the reason for this was the difficulty of devising tangible solutions that keep ABC Systems simultaneously fit for both new and old businesses. Strangely enough, some participants still felt that discussions were dominated by one or a few persons. Three people (strongly) agreed on both questionnaires that discussions in the sessions were dominated. Apparently, for these managers, the opportunity to engage in a discussion and the amount of speaking time people actually take are two different matters altogether.

In sum, we may conclude that in this project modeling was successful in sharing mental models and creating an open sphere of communication, particularly when compared to these managers' normal situation. The relationship between the degree of structure, openness and domination of discussions remains unclear from the data in this study.

Consensus and commitment

From the questionnaire it appears that the modeling sessions were successful in promoting consensus. Most participants (strongly) agreed on both questionnaires that a shared understanding of the problem had been developed, and that the causal diagrams were the result of the integration of the ideas of all participants. Participants considered the project successful in aligning viewpoints. After the first two sessions, three participants and, after the fifth session, five participants agreed with this statement.

The question whether a complete consensus was established yields less positive results. Three persons agreed and two disagreed in the first evaluation and two participants agreed and one disagreed in the second evaluation, that a consensus was reached. In sum, the conclusion is that the project succeeded in bringing about a convergence of opinions about the problem. The project did not, however, create a full consensus on a potential course of action.

It also seems safe to conclude that the participants feel that commitment to the conclusions and recommendations of the sessions has been achieved. Most participants (fully) supported the conclusions of the project. Most also (strongly) agreed that group model building leads to plans that will be loyally implemented (one person had no opinion in the first evaluation; one person disagreed in the second one). Almost all participants agreed or strongly agreed that they would communicate and defend the conclusions to other people in

the organization and persuade others in the organization of their importance. However, the proposition that the conclusions would influence their future actions did not meet with this positive response. In the first questionnaire two managers did not agree with this proposition and two did, while in the second questionnaire only one participant agreed (others did not fill this question out or had no opinion). This point is clarified if we take the opinion that most managers stated in their interviews into account: the project succeeded in creating insight and awareness, but no tangible solutions were developed which the managers themselves could follow up.

Efficiency and effectiveness

As we explained at the beginning of the article, the question was not only whether group model-building could induce a change process in ABC Systems, but also whether this could be established in a time-efficient manner. According to the responses in the questionnaires, the managers were quite enthusiastic about the effectiveness and efficiency of the method. All participants agreed with the proposition: "This method gives faster insight than ordinary meetings." Three participants agreed in the first questionnaire with the proposition: "This method creates a shared vision quicker," whereas four persons agreed in the second questionnaire.

Reflections on the case

The question can be raised as to what led to the favourable outcomes of this project and why we were not completely successful in creating a full consensus and commitment. A useful way to obtain more insight is to reflect back on the project and to come up with the hypotheses which might be tested in future projects. In order to generate hypotheses it may well be advisable to rely on well established theories. In this project we have been dealing with the problem of changing attitudes and behavior. To guide our reflections on the project, let us take a look at an accepted theory on attitude formation and behavior.

Social psychological theories on attitude formation and behavior

A well-known contemporary social psychological theory that explains and predicts behavior is the theory of planned behavior (Ajzen 1988; Fishbein and

Ajzen 1975). The theory both draws on a long tradition in social psychology and is well supported by empirical evidence. A conceptual model of the theory is presented below, and is illustrated in Figure 3.

Intention

The most important determinant of behavior in Ajzen's theory is the intention to perform a behavior. Intentions capture the motivation to act: "they are indications of how hard people are willing to try, of how much effort they are planning to exert, in order to perform a behavior" (Ajzen 1991: 181). The stronger the intention to perform a certain behavior the more likely the behavior is to occur. Ajzen's definition of the concept "intention to act" reveals that it is quite similar to the concept of commitment to a course of action which is more customary in the business-consulting and strategic decision-making literature. According to Webster's dictionary, commitment means: "an agreement or pledge to do something in the future, the state of being obligated or emotionally impelled." The evaluation results indicated a relatively high level of commitment with the results of the group model-building outcomes. The question is: what might have caused this? Ajzen's theory implies that the intention to perform a behavior, or for that matter commitment, is in turn

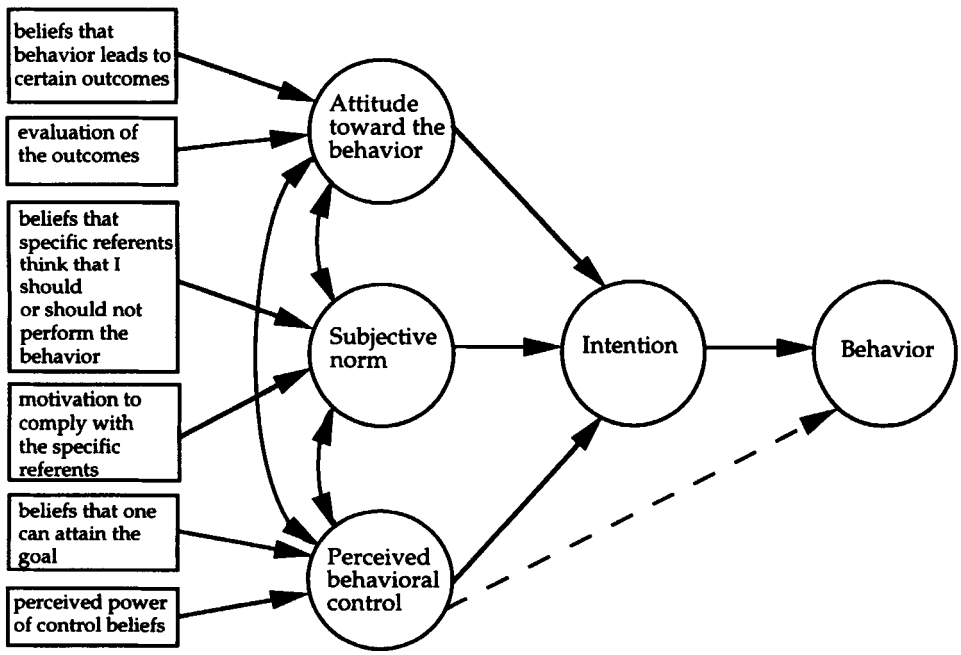

Fig. 3. Theory of planned behavior (adapted from Ajzen 1991: 182) See note 2

determined by three different factors: a persons' attitude toward the behavior in question, the so-called subjective norm and perceived behavioral control. We may assume that one or more of these determinants must have changed during the course of the model-building process to produce the eventual change in commitment. Let us take a look at each of these factors in more detail.

Attitude toward the behavior

The attitude toward the behavior is the degree to which a person makes a favorable or unfavorable appraisal of the behavior in question. The more favorable the appraisal, the higher the intention to demonstrate a specific behavior. Beliefs that link a behavior to a certain outcome or other attribute create the attitude toward the behavior. Because the associated outcomes or attributes are already valued in some way, an attitude toward the behavior is taken immediately.

A more important question is how attitudes change. In social psychology two models of attitude formation and change stand out, the Heuristic Systematic Model (HSM: Chaiken *et al.* 1989) and the Elaboration Likelihood Model (ELM: Petty and Cacioppo 1986). In both models two routes are available in which attitudes can be changed. One route consists of understanding and evaluation of arguments. Following the second route, attitudes are changed on the basis of simple decision rules or heuristics, e.g. "the expert's information can be trusted". According to HSM and ELM, in a situation of high personal ("outcome") relevance or in which a subject is already knowledgeable about the subject, the first route, i.e. understanding and evaluation of arguments, is more important. This route seems more relevant to our case. We may assume that the managers in question are relatively knowledgeable about the subject. However, other factors, such as message comprehensibility and attention of the subject, have to be sufficient to enable a subject to consider all relevant information. Group model-building is generally helpful in processing and integrating a large amount of information, provided that the facilitator succeeds in creating a sphere of open and supportive communication in which mental models can be shared and explored freely (Gibb 1960; Leathers 1972; Senge 1990). Above we have seen that participants rated the communication sphere as open and thus a large number of arguments and a large amount of information were processed.

The question remains as to how group model-building helped to shape the change in attitude towards co-operation. For this we have to assume that there is an outcome which is valued by the participants and that this outcome is

positively linked to co-operation. If we assume, which is not at all unreasonable, that participants value the survival of the company positively, then it becomes clear that the change in attitude towards co-operation might have been the result of the fact that during the process of model building a causal relationship between co-operation and the company's survival was established. If survival is positively valued, then according to Ajzen's theory in our case people will also tend to develop a positive attitude towards co-operation, because the latter will help to create the valued outcome. Stated differently, the group model-building process might have been successful in creating a positive attitude towards co-operation because a causal link between co-operation and a positively valued outcome (i.e. survival) was established in the causal diagram. To the extent that managers internalized this knowledge, this may have affected their attitude. It seems plausible to assume the latter, given the quotations from the interviews presented at the end of the section on learning and changing insights.

Subjective norm

Next to attitude, the second determinant of the intention to show a particular behavior is the subjective norm. The subjective norm consists of the likelihood that important referents approve or disapprove of performing a behavior (strength of the normative belief), combined with the person's motivation to comply with these referents (evaluation of the belief). Stated differently, the more important referents approve of a specific behavior or the more a person is inclined to go along with these referents' opinions, the more likely it is that a person will demonstrate the behavior in question.

In our project we may assume that for each individual manager in the group the other managers serve as his or her referents.[3] Now one can conceive of two extreme situations. One extreme involves a complete divergence of opinions on the importance of co-operation within the group. In this situation the result will be that the subjective norms of the individual managers differ significantly. The other extreme is a complete consensus in the group that co-operation is necessary. In this case there will be a high similarity between the subjective norms of individual managers. In other words, all managers will be drawn toward co-operation. The results of the evaluation have revealed that there was a high degree of consensus within the group with regard to the need for co-operation. In other words, if our previous argument is correct, the high degree of consensus results in a relatively unique and strong subjective norm for each individual manager within the group. And, according to Ajzen's theory, the latter in turn creates a strong commitment or intention to co-operate.

Perceived behavioral control

Let us next take a closer look at the final determinant of the intention to perform a particular behavior, i.e. perceived behavioral control. Perceived behavioral control refers to a person's perception of his or her ability to perform a particular behavior. In our case, for example, the more resources or opportunities for co-operation an ABC Systems' manager perceives and the fewer impediments, the higher the intention to co-operate with other business units. Perceived behavioral control will thus be increased by giving managers a better understanding of the problem and the available courses of action. More specifically, to the extent that the system dynamics model reveals factors that promote co-operation or identifies leverage points in the system, this will boost perceived behavioral control. And, according to Ajzen's theory, this will in turn augment the intention to co-operate.

The evaluation results have revealed that there was a relatively high degree of consensus on the need for co-operation and a rather high level of commitment with regard to the conclusions. However, the results also showed that when it came to implementing co-operation, i.e. the actual behavior involved in co-operation commitment waned. From Ajzen's theory it looks as if this must have been caused by a perceived lack of behavioral control. According to the evaluation results, managers feel that they do not really have control over the behavior in question (i.e. that they will be able to behave co-operatively). This is largely due to the fact that a number of factors affecting collaborative behavior are outside the control of these managers (i.e. selection mechanisms, reward systems and value statements issued by top management and a concrete action programme aimed at changing the organizational structure). Interestingly enough, from a comparison of the kinds of solutions to the problems that were filled out before and after the project, it is apparent that before the project the emphasis was on measures to be taken for the whole of the company and after the project the emphasis was on measures that could be taken at the business unit level. It seems as if the managers were looking for ways to increase their perceived control of the situation, although they were simultaneously aware of the factors outside of their control, limiting the potential effectiveness of their behaviors.

Conclusions and discussion

Strategic decision making not only implies finding the "correct" decision; frequently it also entails the creation of a platform for change. In group model building much effort is devoted to changing the mental models of participants. Richardson *et al.* (1994) argue that such a mental model cannot be seen

as a representation of system structure only. In their view, a mental model consists of an ends model, a means model and a means/ends model. An ends model captures information about what a person tries to accomplish in a situation. The social-psychological theories used in this article demonstrate that these ends can be thought of as behavioral goals, towards which people form an intention. This approach incorporates the social aspects of cognition in addition to the information-processing side, which seems to be the central focus in most system dynamics literature and research. When group model-building is used to induce strategic change, this implies that solely changing knowledge about a problem is not sufficient to alter behavior (see also Fiske and Linville 1980).

In this study Ajzen's (1991) theory of planned behavior was used as a heuristic to describe the relations between group model-building practice and commitment to potential strategies. The description reveals that more than just understanding of the problem and the identification of policies is necessary to lead policy makers into putting decisions into action. Apart from ability, the motivation of policy makers to perform actions determines their intention to act. In Ajzen's theory the perceived control over actions, the opinion of important referents and the attitude toward behavior are important in establishing commitment or intention to act.

In this case group model building was largely successful in changing these three determinants of intention. Modelling ABC Systems' problem showed that lack of co-operation would have undesirable consequences. In this way a more positive attitude toward co-operation was created. In the sessions the problem was thoroughly analysed, as is evidenced by the opinion of most participants that the sessions increased strategic learning. However, a number of the identified factors influencing co-operative behavior were outside managers' control. Perceived behavioral control was therefore not optimal. As a result, it is not surprising to see that a consensual subjective norm has been created about the problem, but not one about possible actions to alleviate the problem. It is clear that in this case changes in attitude toward the behavior, subjective norm and perceived control mainly concern the conclusions drawn about the problem. The identified factors that managers were unable to influence made it difficult to draw conclusions about a possible action plan. Commitment or intention to act is therefore established, but not at the level of concrete behavior. As appears in the last section, participants felt that group model building was efficient in establishing these results.

The case also convincingly demonstrates that this type of strategic change can be established effectively by qualitative system dynamics (Wolstenholme, 1990). The qualitative techniques used in this case were successful in creating learning and in establishing commitment to behavioral change. In this study a

comprehensive analysis of the problem situation and identification of leverage points was made without quantification of the model.

The social-psychological framework of attitude formation and the impact of attitudes on behavior offers, in our view, a very profitable source of hypotheses relevant for system dynamics, in particular for group model-building. Research in this area certainly seems promising and could enrich system dynamics with a broader view of organizational and strategic change.

Notes

1. This procedure was adapted from Terry Hill's work on order winning criteria and process choice (Hill 1985).
2. The arrows in Figure 3 represent sufficient conditions leading to the connected constructs. The double-headed arrows denote possible interactions between constructs. Interactions between attitude, subjective norm and behavioral control have not received much attention in research in behavioral antecedents (see Eagly and Chaiken 1993 for a discussion). According to Ajzen (1991) perceived behavioral control influences behavior directly if it represents actual control, and through the psychological route of increasing effort put into a behavior. Hence the broken line between perceived behavioral control and behavior.
3. For reasons of simplicity we have disregarded the fact that each manager might have other important referents which are not included in the group. Although this may be the case, this issue could not be studied in this project.

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