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Building Consensus in Strategic Decision Making: System Dynamics as a Group Support System

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Abstract.

System dynamics was originally founded as a method for modeling and simulating the behavior of industrial systems. In recent years it is increasingly employed as a Group Support System for strategic decision-making groups. The model is constructed in direct interaction with a management team, and the procedure is generally referred to as group model-building. The model can be conceptual (qualitative) or a full-blown (quantitative) computer simulation model. In this article, a case is described in which a qualitative system dynamics model was built to support strategic decision making in a Dutch government agency.

Since people from different departments held strongly opposite viewpoints on the strategy, the agency had discussed its strategic problem for more than a year, but was obviously not able to reach consensus. The application of group model-building was successful in integrating opposite points of view, as well as in fostering consensus and creating commitment.

The purpose of the article is twofold. first, to illustrate the process of group model-building with system dynamics; second, to evaluate why it was successful. Evaluation results reveal the importance of both systemic thinking through model-building and the role of the facilitator in catalyzing the strategic decision-making process.

Key Words: group support systems, group facilitation, consensus, commitment, strategic decision making, knowledge elicitation, group model-building

1. Introduction

The number of Group (Decision) Support Systems has increased rapidly over the last decades. Various authors have made attempts to provide classifications. DeSanctis and Gallupe, for instance, distinguish between three levels of GDSS. Level 1 GDSS provide features for removing communication barriers in groups; level 2 GDSS contain decision modeling and group decision techniques; and level 3 GDSS are characterized by machine-induced communication patterns (DeSanctis and Gallupe 1987, pp. 593-594). In this classification, all GDSS are assumed to include some kind of computer technology. Ackermann and Eden take a wider perspective and make a distinction between Group Decision Support Systems which involve direct keyboard entry from group members and those which are primarily facilitator driven. The latter are subdivided into systems with and without computer support (Ackermann and Eden 1991; Eden 1992a). System dynamics is a Group Support System which belongs to the facilitator driven category (Eden 1992b). It was originally developed by Forrester at M.I.T. as a method for simulating and exploring the behavior of industrial systems as a result of a number of interlocked positive and negative feedback loops (Forrester 1961). In the last decade, system dynamics has increasingly been

applied, both in a qualitative mode (Wolstenholme 1982; Wolstenholme and Coyle 1983; Wolstenholme 1990) and in the form of quantitative computer simulation, to support strategic decision-making groups (see Morecroft and Sterman 1992). In the qualitative mode, a causal diagram (or sometimes a flow diagram) is constructed with a client group, without computer support. The model-building process is facilitated by at least one experienced system dynamicist who also acts as the group faciliator. In the quantitative mode, a full-blown system dynamics model is constructed and simulated on a computer. This model enables the user to reliably explore the dynamic characteristics of the system under study. In this situation, which is more complicated to handle, the process is generally guided by at least two persons: a group facilitator and an experienced system dynamics model-builder (cf. Richardson et al. 1992).

Group model-building can have a number of advantages for strategic decision-making groups. First, it is claimed to increase team learning and promote insight into the strategic problem (Senge 1990; Lane 1992; Morecroft and Sterman 1992). Many strategic problems can be characterized as messy problems. Frequently these defy a clear and straightforward definition. Group model-building assists in arriving at a shared understanding of the problem which the group faces. Second, models are claimed to be excellent communication tools (Quade 1982; Meadows and Robinson 1985). They force people to accurately express their ideas and opinions and prevent group members from making contributions which are highly equivocal. Although equivocality may be useful in maintaining the balance of the negotiated social order (Eden 1992a), it can also obstruct the decision-making process and affect the quality of decision making (Leathers 1972). The third advantage is that group model-building is claimed to create consensus. Research has demonstrated that premature consensus and concurrence seeking can have detrimental effects (Janis 1972; Janis and Mann 1977; Hirokawa 1985; Hirokawa and Rost 1992). However, consensus after careful consideration of the problem and the available alternatives is a very effective way to make decisions, since it generally entails commitment with the decision by the participants in the process (Schein 1969).

Only a limited number of studies have tried to empirically evaluate the above claims. Empirical evaluation of GSSS is frought with problems. A number of researchers have relied on laboratory experiments, for instance, to evaluate the effectiveness of electronic brainstorming (Gallupe et al. 1991) and the role of the facilitator (George et al. 1992). Although controlled experiments provide the researcher with the largest degree of control over the research situation, the design is generally questioned for its external validity. In case of the so-called facilitator-driven systems, experimental evaluation is extremely difficult if not impossible. Eden (1992c) has argued that these systems cannot be evaluated by controlled experiments, primarily because they aim to solve a real problem with real managerial teams and they involve a commitment to act. However, controlled experiments are not the only way to improve understanding of the effectiveness of a GDSS. Carefully conducted case studies can also provide insights into the actual processes taking place, as well as the factors promoting success or failure of the GDSS.

In this article, I will follow this approach. A case is presented in which (qualitative) system dynamics group model-building was applied to support a strategic decision-making process in a Dutch government agency. The agency had discussed its strategic problem for more than a year, but had obviously not been able to reach consensus. On the contrary.

People from different departments held strongly opposite viewpoints, and these seemed to become more rigid as time passed. The case demonstrates the complexity and fuzziness of the strategic issue and the different types of problems at different levels which had to be tackled so as to successfully complete the project. After the description of the case, I will discuss the results of an evaluation of the claimed advantages of group model-building, as indicated above.

2. Initial contacts with the client organization

Between January 1991 and December 1992, I was involved in the so-called "Nostradamus" management development program at the Directorate General of Public Works and Water Management (DGPW). DGPW is a government agency and belongs to the Department of Transportation, Public Works, and Water Management (DTPW). Besides DGPW, there is a Directorate General for Traffic and Transport (DGTT), and one for Shipping and Maritime Affairs (DGSM). The objective of the "Nostradamus" management development program in DGPW was to improve the strategic thinking skills of their 25 management teams. For this purpose, scenario planning (De Geus 1988; Schoemaker 1993), the hexagon method (Hodgson 1992), and (qualitative) system dynamics were used in the training program. I was specifically hired by the DGPW to facilitate system dynamics group model-building sessions to support strategic discussions within management teams.

Two members of the strategic staff of another Directorate General, i.e., the Directorate General for Shipping and Maritime Affairs (DGSM), were also involved in this project and attended a couple of system dynamics model-building demonstration sessions. During one of the demonstration sessions in March 1992, these two persons approached me, requesting whether I was interested in conducting a couple of model-building sessions for the Long Term Strategy Group of DGSM. I was told that the issue to be modeled was related to the Dutch-registered merchant fleet. For reasons of economy, more and more shipowners had restorted to so-called "flags of convenience." As a result, the number of merchant vessels flying the Dutch flag had been steadily decreasing over recent decades. In an attempt to reverse this trend, the government had financially supported the Dutch fleet in the past. Over the years, however, the financial support program had not proved to be successful.

As could be expected, DGSM, carrying responsibility for Shipping and Maritime Affairs, was worried about this situation. The Long Term Strategy Group of DGSM (consisting of its various unit heads) had been discussing the problem for some time, but had not been able to agree on how to solve it. My two spokespersons had the impression that the Long Term Strategy Group had not discussed the topic thoroughly enough. After having attended the demonstration session, they somehow had the feeling that approaching this problem with the aid of system dynamics group model-building would help to make each person's mental model on the issue explicit, provide fresh insights, and potentially generate new solutions.

Since, at that moment, we had little time to discuss the matter further, it was agreed to have another meeting a couple of weeks later. As a preparation, they sent some relevant policy documents.

3. The problem of the Dutch-registered merchant fleet

For centuries, the Netherlands has been a major maritime nation and has always played an important role in the maritime transportation of goods throughout the world. Since World War II, however, things have changed dramatically for traditional maritime nations. The capacity of the world merchant fleet has increased fourfold, while at the same time the U.S. and the European share in this fleet have gradually but persistently decreased. The Dutch share in the world fleet decreased from more than 4% to less than 1% in 1990 (Voorlopige Raad voor Verkeer en Waterstaat 1992, p. 4). These dramatic changes have, among other causes, derived from differences between countries with regard to wage costs, fiscal policies, and safety requirements. For economic reasons, many shipowners were compelled to resort to so-called "flags of convenience" (e.g., Liberia and Panama). In particular, during the 1960s, competition for the Dutch commercial fleet increased significantly. It was, however, not before the beginning of the seventies that the Dutch government adopted a policy to protect the Dutch-registered fleet by means of investment premiums and tax incentives. The policy seemed a success, because until the mid-1980s the size of the Dutch commercial fleet stabilized at about 800 vessels, while at the same time the Northwest European fleet decreased by about 50% (in tonnages). However, due to the rapidly decreasing economic situation, after the mid-1980s, the Dutch government was forced to introduce new financial aid programs in order to encourage vessels to continue to fly the Dutch flag and to maintain employment in the maritime sector. In 1987, it was decided to continue and further increase the investment premiums on the construction of new vessels and the tax exemption program. The latter aimed at reducing gross wage costs of crews. In addition, a number of regulations regarding crew composition were relaxed. Again, these measures seemed successful; the decreasing trend in the number of ships flying the Dutch flag ceased and even showed a slight reversal in 1990. This recovery did not last, however. After 1990, the decline in the size of the Dutch fleet resumed. Once again a new financial aid program seemed to be required to reverse this trend. Several studies were conducted to identify policies which could increase the viability of the Dutch fleet. These studies indicated that the existing investment and tax programs had to be both diversified and expanded to be effective (DGSM 1992).

As my spokespersons told me in the next meeting, however, the political scene had changed radically in a couple of years. In contrast to 1987, the government was now much less inclined to continue financial support to the Dutch-registered merchant fleet. One reason was the large budget deficit which had to be reduced. Another was the fact that in the recent past several cases had been made public in which the government had provided large sums of subsidies to insolvent companies. In retrospect, these proved to be a waste of the taxpayer's money. Since financial aid programs for the Dutch fleet had not been very successful in the past, the secretary of the Department of Transportation and Public Works (DTPW) was probably afraid of being accused of "pouring the taxpayer's money down the drain." By the end of 1991, the financial support program was drawing near the end of its term. Both the Secretary of Finance and the Secretary of DTPW seriously considered ceasing financial aid to the Dutch-registered merchant fleet.

A number of people in DGSM regarded this as a hasty decision. They considered it impossible that the government would be able to estimate the potential consequences of

such a radical resolution. In their opinion, the problem would have to be analyzed more rigorously before such an important decision could be warranted. As stated, my spokespersons felt that this might be accomplished by applying system dynamics model-building to the problem.

4. The group model-building sessions

However, time was limited. Since the secretary of DTPW had suggested stopping the financial aid program and a decision by the Lower and Upper Chambers was approaching, my spokespersons wanted to start the project as soon as possible, and preferably to finish it within a couple of weeks. As a result, there was no opportunity to prepare the group model-building sessions by means of interviews or questionnaires, as is frequently the case (see Richmond 1987; Vennix et al. 1990). Instead, three group model-building sessions of three hours each were planned in April and May 1992. It was agreed that after three sessions the situation would be evaluated and a decision would be made as to whether or not to continue model-building. To further speed up the model-building process, the three sessions would be interspersed with workbooks. Workbooks can be considered as a special kind of questionnaire with a flexible format, in which participants are invited to perform certain tasks (e.g., brainstorm variables) and to provide comments on submodels which have been developed in the sessions (see Vennix and Gubbels 1994). Normally these workbooks are designed by the project group, but in this case one of my two spokespersons, who acted as the Long Term Strategy Group's secretary, took care of this. This person also acted as a gatekeeper during the project (Richardson et al. 1992; Eden and Simpson 1989, p. 65–66).

4.1. The first session

Since the group was not familiar with system dynamics, I started the first session with a brief one-hour introduction to system dynamics and group model-building. The presentation was illustrated by an example of a previous project, in order to demonstrate to group members what was expected from them and what they, in turn, could expect from the sessions.

After this short introduction, I started the group model-building process by introducing the problem of the declining size of the Dutch-registered merchant fleet. This immediately gave rise to a heated debate in which several persons indicated that this was only a minor problem and that, instead of addressing it, the group should focus on more important problems related to the Dutch coast and Dutch ports. Gradually it became clear to me that there were truly divergent perspectives within the division about its preferred strategy.

In fact, only one group, i.e., the Sea Fleet Policy Unit within DGSM, was most worried about the "decreasing fleet size problem." This unit is largely responsible for the Dutch-registered merchant fleet. Termination of the financial aid program would jeopardize their position within the DGSM. In addition, many within this unit felt that support for the Dutch fleet could not just simply be abandoned, since in the long run this would mean giving up the historic position of the Netherlands as a maritime nation. People within the Sea

Fleet Policy Unit felt strongly that something needed to be done to stop the reduction in the numbers of vessels flying the Dutch flag. As early as the beginning of 1991, the unit had started to prepare a policy document in order to find renewed governmental support for the Dutch fleet.

However, in addition to the Dutch commercial fleet, DGSM is responsible for two other strategic areas. The first is related to the Dutch ports (i.e., Rotterdam and Amsterdam) and involves such tasks as accomplishing further innovation in the ports, maintaining safety, and gearing activities and transportation modalities to one another. The second area concerns the advancement of safe and swift shipping traffic on the North Sea. Some of the people involved in these latter two strategic areas had strong doubts about the viability of the Dutch commercial fleet. They basically agreed with the secretary of DTPW's position of abandoning government support and were not inclined to back up the policy document prepared by the Sea Fleet Policy Unit. In their view, the Dutch fleet was "history," and the other two strategic issues would prove to be much more critical in a rapidly changing world. Rather than a large commercial fleet, they believed that such matters as telematics, logistics, and floor-to-floor management would become increasingly important. As a result, these people proposed to cease interference with the Dutch fleet altogether in order to be able to more fully concentrate future activities of the agency on the other two strategic areas.

By the beginning of 1992, this discussion had lasted for more than a year, and the Long Term Strategy Group obviously had not reached a consensual decision. Quite the opposite, it seemed that over time arguments and positions had become more rigid. This clearly surfaced during the first group model-building session when I introduced the problem to be modeled. Not only was there a heated debate about this issue, but some persons even refused to take the "decreasing Dutch fleet" problem as a starting point for model-building. It looked as if the discussion would get stuck at the start of the first session.

In order to overcome this deadlock, I asked several group members why they considered the "fleet problem" unimportant. Their answers suggested to me that they saw it as an isolated phenomenon, unrelated to the other two strategic problems. I told the group that from a systems perspective, it would probably make little difference which of the three strategic issues was taken as a starting point for group model-building. Most probably, the three would prove to be interrelated. I argued that whatever strategic issue was taken as a starting point, the other issues would almost automatically come into focus during construction of the model. This (at least temporarily) convinced most of the sceptical group members, and a deal was made that if "their problems" did not surface within a couple of sessions the issue would be rediscussed. As a result, the problem of the Dutch-registered merchant fleet was taken as the preliminary starting point.

During this discussion, I had also noted that group members held ideas and opinions which were rather rigid, something which frequently happens when a group is not able to reach a consensual decision. In such cases, people generally increase their efforts to convince others of the correctness of their viewpoint, which generally produces the opposite effect. As a result, the group had a communication problem: people hardly listened to each other's arguments and made frequent interruptions. In order to break through this ineffective communication pattern, I employed elements from the Nominal Group Technique (Delbecq et al. 1975) to start the model-building process. The NGT approach for group model-building consists of the following steps.

After defining the initial problem, participants are invited to generate relevant variables in silence and to write them down. After the group has finished this step, the facilitator invites group members in a round-robin fashion to name one variable from their list. Each variable is written on a magnetic hexagon (Hodgson 1992) and put on a white board (see left-hand part of Figure 1). When no more variables are generated, the facilitator starts building the causal diagram by selecting the problem variable (in our case the "number of ships flying the Dutch flag") and putting it on a separate white board. Next (s)he asks participants to identify the causes for increases or decreases in the number of ships, by looking at the list of generated variables. These are then transferred to the other white board and built into the diagram, as can be seen in the right-hand part of Figure 1.

Arrows denote causal relationships between variables, where a "+" sign means a positive, and a "−" sign a negative effect. In Figure 1, the variable, "number of ships flying Dutch flag," shows only incoming arrows. (These are the potential causes of the problem.) The arrows can be read as follows: "the more (less) available capital, the more (less) investment decisions will be made. This leads to a higher (lower) number of new ships in the Dutch fleet and hence to a larger (smaller) number of ships flying the Dutch flag." Note that all individual relationships between two variables are valid under the "ceteris paribus" clause, i.e., they are valid if the other variables are simultaneously kept unchanged.

Having finished this step, the facilitator then asks the group to consider the consequences of changes in the problem variable, again by looking at the list of variables. These will show in the diagram as arrows "leaving" the problem variable. Simultaneously, the facilitator invites the group to look for connections between consequences and causes, i.e., consequences which, in turn, can be considered as causes of the "original" causes. This will lead to the identification of potential feeback loops, which constitute the core of system dynamics models. The latter two steps will be illustrated in the next sections.

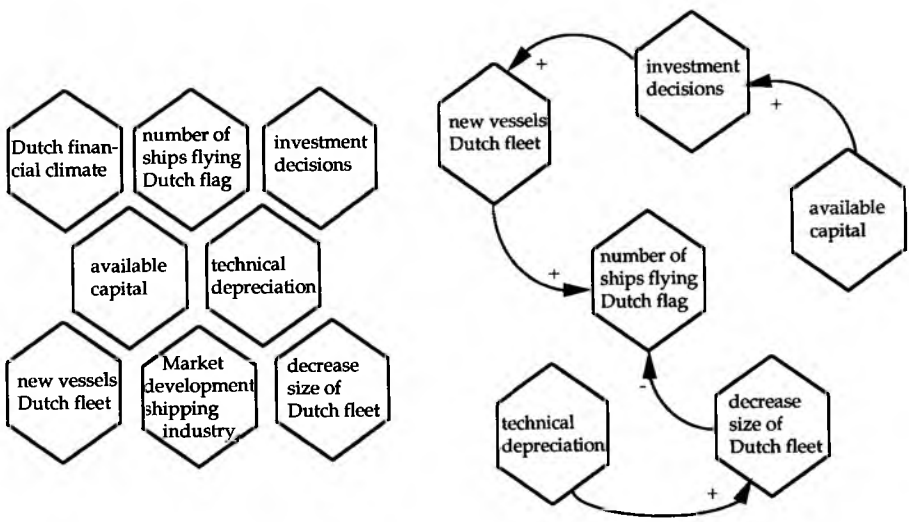

Figure 1. Example of use of hexagons in system dynamics group model-building.

As a consequence of the introduction and the discussion on which problem to model, the actual model-building time in the first session was limited. The session ended with a causal diagram (Figure 2) which merely identified a number of causes of the decreasing number of ships flying the Dutch flag.

This diagram was sent to the group members with a couple of accompanying tasks in the form of a small workbook. Three tasks had to be performed. First, the participant was asked to further complete the diagram; second, to indicate which variables represented the most urgent problems for DGSM; and, finally, to identify potential consequences of a decrease in the Dutch fleet's size. In previous projects, I had always had good experiences with workbooks as a means of speeding up the model-building process and of preparing participants for the next session (see Vennix and Gubbels 1994; Akkermans et al. 1993). Unfortunately, in this case, only two out of nine participants reacted to the questions. One of the potential reasons for this lack of cooperation was that persons were trying to protect their positions by an attempt to postpone or prevent a strategic decision's being taken by the organization. Although the number of reactions was disappointing I proceeded as usual and added the changes made in the diagrams contained in the two workbooks to the causal diagram that had resulted from the first session. This adapted diagram was taken as a starting point for the second session.

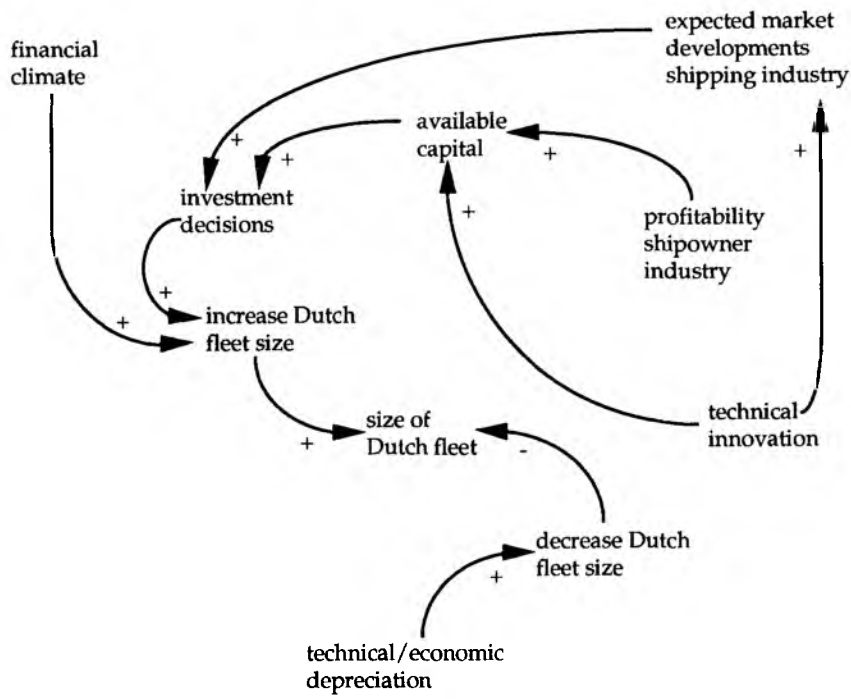

Figure 2. Causal diagram after first session: causes of problem.

4.2. The second session

Another problem was that some persons were a little reluctant to participate in the sessions. They did not attend the second session but (at our specific request) sent substitutes. Although this disturbed the process, it also proved beneficial in the longer run, because more persons from DGSM got involved in the strategic discussion, often leading to new and fresh perspectives on the matter. The second session was started with the adapted diagram from the first session. The basic idea was to improve the diagram and, in particular, to focus on the consequences of the decreasing fleet size. However, one of the substitutes, who was very knowledgeable about the process of investment by shipowners, came up with a more detailed diagram of the investment decision process of shipowners. I invited him to present it to the group. After having discussed his diagram, the discussion shifted to the question of the consequences of the decreasing size of the Dutch fleet for the DGSM organization. At this point, the discussion waned. Obviously, thinking of likely future consequences is more difficult than suggesting causes of a problem (see Russo and Schoemaker 1989). In order to stimulate thinking about this issue, I made the group conduct a "mental simulation" (Kahneman and Tversky 1982; Sims 1986), by asking the following question: "Suppose that the number of vessels flying the Dutch flag were gradually, but within a few years, to decrease to zero. What do you think would happen?" This question helped to produce some interesting reactions. It was felt by the group that a distinction had to be made between the effects of having no vessels flying the Dutch flag versus having no vessels being managed in the Netherlands. In addition, potential effects for DGSM were separated from those for the maritime policy area. A four-cell matrix was applied in order to arrange potential consequences, as can be seen in Figure 3.

With regard to the causal diagram, only the lower half of the matrix is important, since it shows the potential effects of a sharp decline in the size of the fleet flying the Dutch flag. We started including these potential effects (of the lower half of the matrix) in the

	Effects For	
Decrease in Size of	DGSM Organization	Maritime Policy Area
Dutch-managed fleet	• weaker position within DTPW • loss of technical/nautical know-how • smaller organization	• weaker international influence • decrease contribution to GNP
Fleet flying the Dutch flag	• smaller organization • loss of technical/nautical know-how • weaker position of DGSM within DTPW • less "qualitative" departments • increase in attention to Dutch ports and Dutch coast	• decrease contribution to GNP • weaker position in international maritime organizations • increase in attention to Dutch ports and Dutch coast • loss of sailors (with consequences for maritime education) • loss of technical/nautical know-how

Figure 3. Potential effects of a decrease in the size of (1) a Dutch-managed fleet, and (2) merchant fleet flying the Dutch flag for (a) DGSM and (b) the maritime policy area in general.

diagram. Some of these were rather straightforward and easy to include. Some were more difficult, because there was no consensus on them. A couple led to the identification of (what would later prove to be crucial) feedback loops. The effects on the number of sailors, the Dutch economy (balance of payments), and the loss of technical know-how were rather straightforward. Most of the discussion focused on the effects on the position of DGSM within the Department of Transportation and Public Works (DTPW). Of course, this position is determined by all three strategic areas: the size of the ports, the maritime traffic on the North Sea, and the size of the Dutch fleet. With regard to this latter variable, the group was convinced that a sharp decrease in the size of the Dutch-registered merchant fleet would undermine the strength of the position of the division within the department of DTPW. In addition, it would decrease the size of DGSM itself, which would further reinforce the latter process. The weakened position of DGSM would, in turn, lead to a further decline in the Dutch fleet, because it was felt that no other agency had the appropriate network or experience to develop effective policies for it. As a result of these discussions, two positive feedback loops emerged in the diagram, as can be seen in Figure 4. The loops are indicated by the bold arrows.

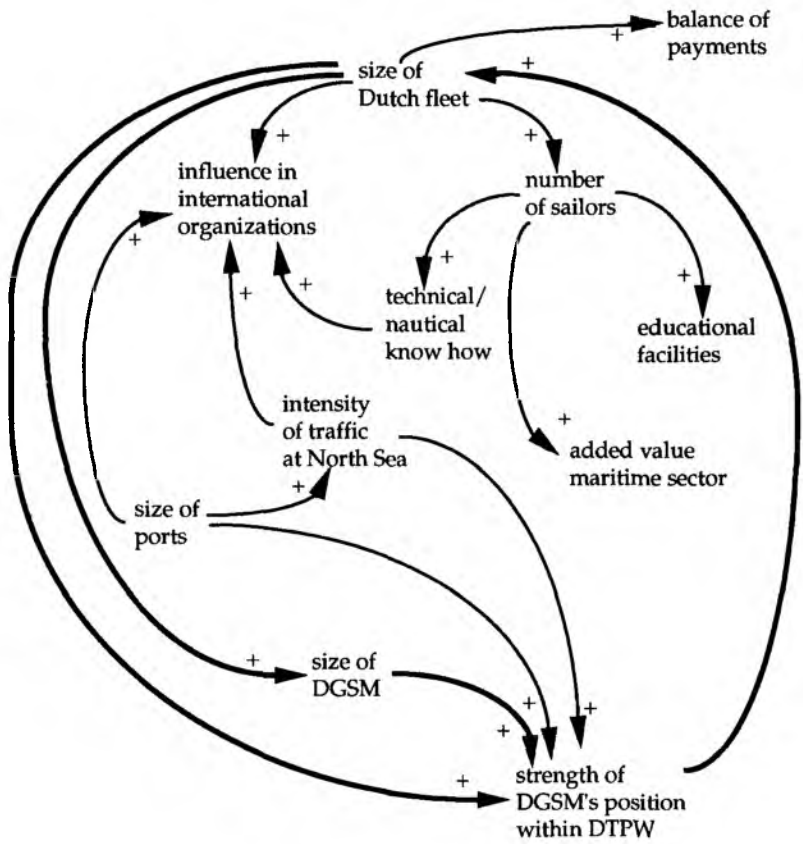

Figure 4. Causal diagram after second session: consequences of problem.

This figure is the result of the discussion on the consequences of a decreasing Dutch-fleet size. The two positive feedback loops indicate a self-reinforcing process, i.e., a process of a declining fleet will reinforce itself and hence lead to a further reduction in the fleet size. Due to the emergence of these feedback loops, the first real doubts arose within the whole group about abandoning support for the Dutch fleet, since in the long run this might undermine the strength of DGSM within DTPW, as well as their influence in international organizations. This, in turn, might affect the potential to carry out the other two strategic tasks effectively. Although these latter thoughts did not yet neatly materialize in the above diagram, it started to dawn in people's minds that the three strategic areas were more closely interrelated than they were previously inclined to believe. For those who were still in doubt, this notion would be strongly reinforced in the third session by another feedback loop which was to emerge in the diagram.

4.3. The third session

One of the effects in the matrix, which had not been discussed in the second session, was the tacitly assumed increase in DGSM's attention to the other two strategic tasks (i.e., ports and coast), once no more attention would have to be given to the Dutch fleet. However, no consensus could be reached on plausible causal links to be put in the causal diagram to support this notion. Quite the contrary was the case. The discussions and the emerging feedback loops were suggesting that the smaller the Dutch fleet the *more difficult* it would be to carry out the other strategic tasks. This conjecture, which had already surfaced by the end of the second session, was now strongly reinforced by a new feedback loop, which emerged in the diagram as a result of the discussions in this third session. Until 1992, support for the Dutch fleet had primarily been defended because of its direct contribution to the Dutch economy through shipbuilding and repair yards, employment in the ports, training of crews, etc. In the third session, a new notion was added to this argument, while discussing the role of the Netherlands in the whole logistical chain of storage, transshipment, and distribution in Europe. Some people argued that a strong reduction in the number of vessels flying the Dutch flag would in the long run lead to an outflow of a number of shipowners. Without Dutch shipowners, the amount of maritime traffic through the Netherlands, and the size of the Dutch transportation sector, would also decline. As a consequence, this would reduce the distribution function of the Netherlands in Europe. This, in turn, would impede the growth of the Dutch ports, further weakening DGSM's position within DTPW, thus leading to a further decrease in the number of ships flying the Dutch flag and concomitantly to a declining contribution to the Dutch GNP, as can be seen in Figure 5. Again the important feedback loop is indicated by bold arrows.

Figure 5 contains the final diagram detailing the potential consequences of a decreasing fleet size, as it existed at the end of the third session. From a model builder's perspective, the causal diagram is not really finished. There are, for instance, several "open loops," and the submodels (e.g., Figures 2 and 4) are not integrated into one overall model. In addition, no efforts were made to quantify the conceptual model. However, as stated earlier, we had previously agreed that at the end of the third session a decision would be made as to whether or not to continue the model-building process. Although some persons agreed

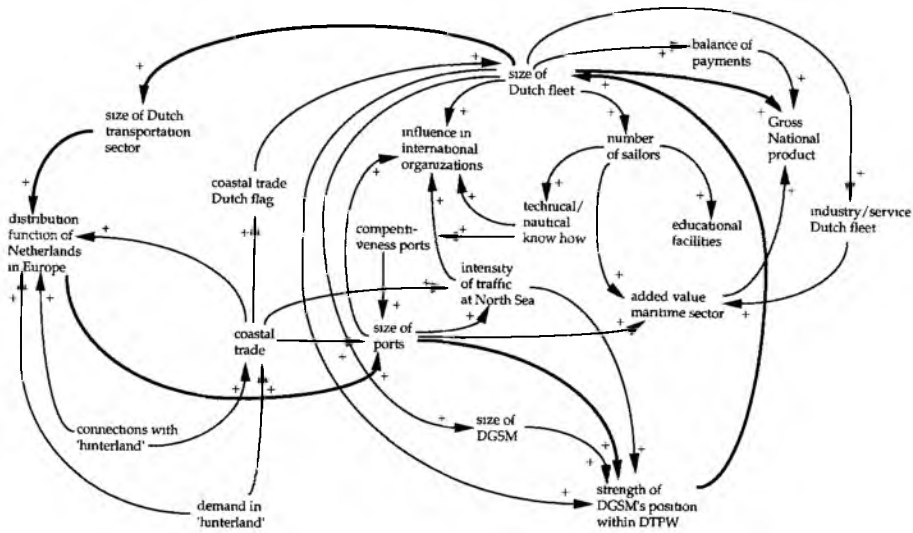

Figure 5. Causal diagram after third session.

with me that the model was not finished, the majority of the group felt that no further sessions were required, a situation which is not uncommon in group model-building (see, for instance, Lane 1992; Wolstenholme 1992).

By the end of the third session, three important conclusions stood out. The first was that abandoning support for the Dutch fleet would most probably jeopardize DGSM's position within DTPW. Second, the *indirect* contribution of the Dutch fleet to the economy, by enhancing the Dutch position as a distributor of goods to Europe, proved to be far more important (particularly in the future) than its *direct* economic contribution. Third, without a Dutch commercial fleet, it would be hard for the Netherlands to maintain its role in international trade as a distributor of goods for Europe.

These three insights changed several people's minds and helped to create consensus within the Long Term Strategic Group about the appropriateness of trying to find ways to continue governmental support for the Dutch fleet. In a sense, the whole group was now ready to back up the policy document from the Sea Fleet Policy Unit, which the latter had initiated at the beginning of 1991.

5. The policy document

What happened to the causal diagrams and how was the strategic decision-making process affected? As stated, the diagrams were never revised or neatly redrawn, nor has there ever been an attempt to formalize and quantify the causal model into a full-blown system dynamics simulation model. In parallel with the system dynamics sessions, the Long Term Strategic Group was still discussing the structure and contents of the final version of the policy document designed to get support for the Dutch fleet, which was to be presented to the Secretary.

This policy document was published in September 1992, about four months after the last session (DGSM 1992). Interestingly enough, there is also a draft version of this policy document dating back to January 1991, more than one and one-half years before. This document was produced by the Sea Fleet Policy Unit, but it was not supported by the whole DGSM organization, as we have indicated in section 4.1. It was precisely this document about which no consensus within the Long Term Strategy Group could be reached. Comparing both policy documents leads to a couple of interesting findings and demonstrates the way in which the model-building sessions affected the strategic decision making process. As might be expected, the contents of both policy documents largely overlap. However, there are also a couple of significant arguments in the final version which are missing in the draft version. These arguments can, at least in part, be traced back to the discussions in the group model-building sessions and the causal diagrams.

The first is related to the influence of the Netherlands in international maritime organizations. In discussing safety and environmental matters and the role of various international organizations, the policy document emphasizes that:

> The strong international character of the maritime sector constrains the possibilities of self-regulation by the industry. International organizations, like the International Maritime Organization (IMO) of the United Nations, are required to arrive at international agreements. The size of a national fleet determines to a large degree the influence a country can exert on decision making within these organizations (DGSM 1992, p. 7, translation J.V.).

The second is that the final verison contains at least six references to the importance of the role of the Netherlands as a distribution country and its importance for the Dutch economy. It is also clearly argued that this function can only be maintained by means of a Dutch fleet.

> And in particular a modern, high quality Dutch fleet with the shipowner as logistic service agent is of great importance for the further reinforcement of the Dutch distribution function for Europe (DGSM 1992, p. 9). And:

> For a number of flows of goods the shipowner is the director of the logistical chain (. . .). From their role as worldwide carriers they attempt to direct as many flows through the Netherlands as possible, because they also have financial interest in Dutch transshipment and distribution companies. This will strengthen the position of "Netherlands distribution country" as gateway to Europe (DGSM 1992, p. 10)

The importance of the latter arguments is reinforced by the fact that these are specifically mentioned by the Secretary in her letter accompanying the policy document to the Lower Chamber:

> The Netherlands has always been an important maritime trading nation. Shipping is an essential link in "Holland distribution country." Strengthening this distribution function can best be accomplished if shipping activities are tied with the Netherlands. In order to accomplish this it is necessary to maintain ships flying the Dutch flag.

In other words, the Secretary, at first unwilling to continue support to the Dutch fleet was now arguing that financial support was necessary in order for the Netherlands to be able to fulfill a significant distribution function for Europe. Obviously, the arguments produced in the policy document (combined with the lobbying efforts of a number of shipowners) had aided in convincing both the Secretary of Finance and DTPW to reconsider their original position to abandon the financial aid program. This is not to say that they had uncritically changed their minds and were now suddenly inclined to provide unlimited support to the Dutch fleet. The Secretary of DTPW also pointed out that in the long run the Dutch fleet ought to be fully competitive and that this type of financial support program had to be made redundant. In order to accomplish this, it was also proposed that international agreements had to be negotiated to abolish financial aid programs in maritime countries in the future. As a result, the policy document suggested providing financial support for a limited time period of five years.

The policy document was used as a basis for the decision in the Lower and Upper Chambers. Obviously, the arguments in the document were also convincing to the members of these two chambers, because they decided to agree with a financial support to the Dutch-registered merchant fleet amounting to about dfl. 150 million per year for a limited period of five years.

6. Contributions from the group model-building process

At the end of the process, there were at least two tangible results. First, as participants indicated on a questionnaire, there was a high level of consensus and commitment with regard to the strategic choice, something which was clearly lacking at the beginning of the process. Second, as a result of this, DGSM gained a financial support of dfl. 150 million per year to protect the Dutch fleet.

The interesting question is to what degree and how system dynamics group model-building contributed to this success. In the remainder of this article, I will try to answer this question. The answer will be based on discussions with the gatekeeper, my own observations of the process, and, last but not least, on the participants' opinions about the process. These opinions were elicited by means of a questionnaire filled out by those who attended at least two of the three sessions. The questionnaire contains a number of Likert items, and respondents were requested to indicate their opinions on a five-point scale ranging from "strongly agree" to "strongly disagree." In my view, three factors are responsible for the success of this project. These three factors partially relate to the most important problems which this particular group was facing at the start of the project. The first is that the model-building process produced new and fresh insights into the strategic issues. Second, the process aided in improving the quality of communication within the group. Third, the group model-building process was successful in fostering consensus and commitment to the final decision. Let us look at each of these factors in more detail.

6.1. Creating new insights: the role of systemic thinking

The first contribution of the process is that it generated a couple of new and fresh insights. Six (out of nine) persons agree that the group model-building process changed their opinions

about the problem, while two persons disagree with this statement, and one neither agrees nor disagrees. Seven persons agree, and one strongly agrees, that the group model-building process increased their insight into the problem. Eight participants agree that the process generated *new* insights into the problem. These concern insights into the causes of the problem, its consequences, and the way to deal with it.

To an outsider these results might look strange. A sceptic might, for instance, argue that it is hard to imagine that people would not have been aware of the importance of the Netherlands as a distribution country and of the fact that shipowners play a role in this process. It would be difficult to deny this. One of the beneficial effects of the group model-building process, however, was that it restructured existing, but scattered, knowledge by putting it in a systemic perspective. It thus revealed relationships between various elements, and, thereby, created new knowledge for the group. A lack of systemic perspective was, for instance, demonstrated in the discussion which took place in the first session concerning which problem to select for the model-building sessions. An indication of this can also be found in an answer from one participant to a question in one of the workbooks: "No, we know almost everything there is to know about this subject, but I have the feeling that we do not interrelate all that we know in an appropriate way."

The above speculation is confirmed by the results of the questionnaire. All participants agree that the process occasioned a more holistic approach to the problem. Two persons agree strongly, and five agree, that the process revealed relationships between elements of the problem. In these answers, the contribution of a systemic approach by means of system dynamics clearly surfaces. The causal diagrams obviously revealed the subtle interrelatedness of the three strategic areas in which DGSM is involved. In that sense, the process also aided in creating a shared understanding of the problem. Two persons agree strongly, and six agree, while one neither agrees nor disagrees with this assessment. Interestingly enough, although the diagrams clearly contain a number of feedback loops, only three persons agree that they gained more insight into the role of feedback processes in the problem. Three persons disagree with this, and three neither agree nor disagree. One reason for this might be that, although the structure of the feedback processes is known, it is extremely difficult to assess their dynamic consequences, particularly if they are interrelated.

6.2. Improving the quality of communication

Another important, maybe even critical, contribution of the group model-building process is the improvement of the quality of communication within the group. As stated, prior to the group model-building sessions, discussions in the Strategy Group were clearly characterized by ineffective communication. People in the Long Term Strategy Group hardly listened to one another, and made frequent interruptions. Empirical research has indicated that low-quality communication negatively affects group performance (Fouriezos, Hutt, and Guetzkow 1950; Gibb 1960; Leathers 1972). These results are corroberated by this case. The Long Term Strategy Group had discussed their strategic plans for more than a year without making any real progress. Hence, one of the first prerequisites for improving performance within this group was to enhance the quality of group communication. This was accomplished in several ways. First, by the use of structured group process techniques (e.g.,

NGT). Various studies have shown the detrimental effect of mixing up brainstorming and evaluation tasks (Brilhart and Jochem 1964; Maier and Thurber 1969). In addition, employing causal diagrams in front of the group creates a visual group memory, helping to retain the flow of the group discussion. Finally, the facilitator can foster an open communication atmosphere by reinforcing supportive communication and avoiding defensive communication (Gibb 1960).

Obviously the above procedures were effective. According to the participants, the group model-building process aided in improving communication in three respects. First, six out of nine group members (strongly) agree that it provided an equal opportunity for all group members to express their opinions. Three persons hold the opinion that discussions were conducted in a structured fashion and that there were no really dominant talkers, four persons neither agreed nor disagreed with these statements, and one person disagreed. Second, six people agreed (strongly) that group model-building aided in explaining one's ideas to others in the group. A couple of respondents also pointed out that the model-building process makes it impossible to "hide behind vague statements" and to obstruct the discussion. As stated before, constructing causal diagrams obviously forces persons to express their ideas more accurately. When it comes to the issue of mutual understanding, seven participants agree that model-building helped to better understand other people's ideas and opinions. Eight acknowledge that it provided more insight into the ideas of other group members. Finally, according to eight participants, employing causal diagrams as a way of capturing people's ideas helped to improve the quality of communication.

6.3. Creating consensus and commitment

Probably the most important result is that the group model-building sessions were successful in fostering consensus. In addition, they created commitment to the decision to attempt to obtain financial support for the Dutch-registered merchant fleet. Eight persons agree that consensus was reached and that group model-building is an appropriate method for integrating different viewpoints. When it comes to commitment, three persons agree, and two strongly agree, that they *fully* stick to the conclusions which were formulated. Two persons neither agree nor disagree, and one person disagrees.[1]

In part, consensus and commitment were created through the systemic insights gained during the model-building process. The notion that abandoning the Dutch fleet might in the long run have serious repercussions for the whole DGSM organization must have helped to create this consensus. Commitment was also affected by appropriate facilitation behavior. Vennix et al. (1993) evaluated four different group model-building projects, which included this case. Their data suggest that the facilitator is probably the most important factor in creating commitment to the decision. Moreover, in all four projects, participants indicated that in their opinion, it was the facilitator who contributed most to the overall success of the project. These results are in agreement with other research in the GDSS field (see Bostrom et al. 1993; Clawson et al. 1993). Since the facilitator role seems so important, let us finally take a brief look at this aspect of group model-building.

6.4. Effective group facilitation

Several authors discuss critical skills for effective group facilitation (see, for instance, Clawson et al. 1993; Phillips and Phillips 1993). In this section, I will briefly discuss a number of attitudes and skills which, in my view, are helpful in concluding a project successfully, as described in this article. For a more elaborate description of group facilitation in system dynamics group model-building, I refer the reader to Vennix (1995).

One important factor is a helping and problem-oriented attitude. The crucial idea is that a good facilitator wants to help a group solve a (strategic) problem rather than build a model. All the behavior of an effective facilitator has to be guided by this idea. And, as this case demonstrates, this is more difficult than it might initially appear to be. Although it originally looked to me as if there were an unambiguous problem to be modeled, the first session clearly proved the opposite. The discussion about what problem to model is part of the process and part of the deliverable (see Lane 1992). Although this problem was "solved" by the suggestion that, in a systemic approach, strategic areas would prove to be interrelated, another equally (or maybe even more) important problem was still left—namely, that of low-quality communication in the group. As stated, the latter is a real obstacle for effective group performance. Hence, not only has an effective facilitator to be problem oriented, in the sense that (s)he wants to aid in solving a strategic problem, but also sensitive to, and work simultaneously at, other problems which impede group performance. In that sense, a facilitator should be aware that the group interaction aspect of strategy formulation is frequently more important than the analytical aspect (Eden 1992a).

Another important factor in this case was the neutrality of the facilitator with regard to the content of discussion. Being neutral implies that a facilitator does not take sides in the discussions. It also means that any group member can air his/her opinions without the facilitator revealing his/her favor or disfavor with regard to the content of what is said, regardless how strange certain ideas might look at first sight and regardless of the person who expresses them. This approach proved to be beneficial, since, in this case, most group members held strong opinions and were hardly inclined to listen to other group members. Particularly when there are strong opposing points of view, contributing to content entails the danger that one ". . . may become drawn into the group's deliberations and may soon be treated as another participant" (Phillips and Phillips 1993, p. 534). The latter will weaken one's position as a facilitator.

A skill which also proved to be beneficial in this case, given the differences of opinion and the fact that people did not really listen, was reflective listening. This skill entails being able to ask clarifying questions in order to make sure that you and (maybe even more importantly) other group members understand what is said. In general, people in small groups have the tendency to provide answers and to give critique and opinions, rather than ask questions (see, for instance, Hare 1962, p. 66), although one frequently feels that there is miscommunication. Jensen and Chilberg (1991, p. 86) and Rees (1991, p. 57) suggest some guidelines which will help in active listening, some of those are: to avoid distractions, to demonstrate that you are listening, not to interrupt, and to avoid thinking ahead to what you are going to say. An effective way of accomplishing reflective listening is to ask questions and to reflect back what one (thinks one) has heard by sentences such as: "so, what you are saying is. . ." or "you mean that. . . ." This type of statement will often serve to prevent miscommunication and to foster a climate in which people will listen to each other's ideas.

Another important skill for a facilitator is being able to increase the level of vigilance in the group. Field and laboratory studies have shown the dangers of groupthink (Janis 1972; Janis and Mann (1977)) and have demonstrated that vigilance in group decision making is more important than type of decision making sequence (Brilhart and Jochem 1964; Bayless 1967; Larson 1969; Hirokawa 1985; Hirokawa and Rost 1992). One of the great advantages of constructing causal diagrams is that it almost automatically forces the group to think critically about their problem and that it challenges hidden assumptions. One clear example from this case is the assumption that abandoning the Dutch fleet would lead to more effort's being put into the other two strategic tasks of DGSM. Causal modeling helped to uncover and refute this tacit assumption. It demonstrated that exactly the opposite was true namely, that less interference with the Dutch fleet would lead to more difficulty in carrying out the other two tasks. Clearly, respondents agree with the fact that model-building forces group participants to think thoroughly about the strategic problem. Two persons agree strongly, and seven agree with the statement: "The model-building process encouraged us to think thoroughly about our problem."

Finally, it is important that a facilitator be able to create consensus and commitment. Active listening and showing a genuine interest in a person's opinions were extremely helpful in this case. Another point in this respect is to conduct the model-building sessions in such a way that the model is owned by the group (Roberts 1978; Phillips and Phillips 1993). If this is the case, there is a certain degree of consensus about the problem, which is a prerequisite for commitment and implementation. From the perspective of ownership, it is important to involve the group as much as possible in the model-building process. Sometimes, group members step forward and start restructuring the model. For instance, this was the case in the second and the third sessions. I consider these as moments when the client starts really owning the model, and I generally encourage this type of situation rather than trying to "stay in control." However, this might prove difficult sometimes, because as Keltner (1989) points out, one of the paradoxes of facilitation is that by teaching the group how to help itself, the facilitator essentially eliminates his own role. But, in fact, the facilitator is accomplishing what a good facilitator should achieve: the group starts helping itself!

7. Discussion and conclusions

In larger organizations differences of opinion frequently exist between members of different departments. A manager's view of the organization and its problems is powerfully determined by his or her place in the organization (Dearborn and Simon 1958; March and Simon 1958). Hall (1984) has clearly demonstrated the potential detrimental effects of "local" viewpoints in a case study of the demise of the *Saturday Evening Post*. One technique for circumventing the problem of "partial viewpoints" is group model-building with system dynamics. In this article, I have described a successful application of group model-building for creating consensus in strategic decision making in a situation having strong controversies. As this case demonstrates, strategic decision making involves more than generating alternatives and making a choice. It is a delicate negotation process about different opinions held by various people. Perception and interpretation are core elements of this process.

As a result, a GDSS to support these processes cannot rely solely on technology. It will always be largely facilitator dependent. Although some experiments indicate that groups without facilitation perform equally well as facilitated groups (e.g., George et al. 1992), it is hard to imagine that this would have been the case in this project (quite the contrary). As stated, the group had been discussing the "fleet problem" for over a year without being able to arrive at a consensus. The group clearly found itself in a blind alley. It is doubtful whether the group would have progressed so quickly without an outside facilitator. The importance of the faciliator thus strongly depends on the type of problem and the organizational circumstances.

As I have pointed out before, from a model-builder's perspective, the model was never really finished. Some people raise the question whether the model is valid or whether valid conclusions can be drawn without computer simulations. They refer to research in behavioral decision making which has demonstrated the human mind's lack of computational capacity. (Hogarth 1987.) As a result, it is impossible to identify the dynamic consequences of changes in a complex system (see Forrester 1987; Sterman 1989a and b). However, to approach the situation from this point of view is to miss the point. The model in this case must be considered a "requisite decision model" (Phillips 1984). It is the result of a shared social reality, which forms the basis for action. In this case, the problem was not so much to find the "right" strategic decision, as to overcome the deadlock and to arrive at consensus and create commitment. This case description also reveals that this is a subtle process in which a balance has to be found between a socially negotiated order and the negotiated social order (Eden 1992a). The evaluation results show that various elements of a GDSS contribute to this result in intricate ways. More in-depth research of actual field applications is needed to increase our understanding of these processes, the way various elements in a GDSS affect them, and how they contribute to the success of a GDSS.

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Note

1. Note that these results are, in fact, better than they might initally appear to be, due to the fact that the statement was formulated in an extreme way, i.e., "I *fully* stick to the conclusions we formulated," rather than the less extreme, "I stick to the conclusions we formulated." Also note that one answer is missing.

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