CHAPTER THREE

Design of the Experimental Study

3.1 INTRODUCTION

If the causal relationships between the variables specified within the research model were to be adequately tested, the required approach had to allow for the systematic manipulation of the independent variables (e.g. type of marketing management support system to be used, amount of time-pressure operated under), and had also to permit the control of other variables (e.g. competitive behaviour). Furthermore, the *process* involved in making decisions while using an MMSS had to be studied over a number of consecutive periods. If these requirements were to be met, a research approach was needed which would make it possible to make a number of controlled observations in time.

Churchill (1991) states that causal studies typically take the form of experiments, since experiments are best suited to determine cause and effect. An experiment, unlike case studies or field studies, is better equipped to supply evidence of causality because of the control it affords investigators. Sawyer, Worthing and Sendak (1979) state that experiments are the only research designs in which causal inferences can be postulated with a high degree of certainty. Perdue and Summers (1986) even see the identification of cause and effect relationships as the "raison d'être" of experimentation.

Two types of experiments can be distinguished: laboratory experiments and field experiments. Churchill (1991) defines the two approaches as follows: "a *laboratory experiment* is one in which an investigator creates a situation with desired conditions and then manipulates some while controlling other variables (p. 176)", and "a *field experiment* is a research study in a realistic or natural situation, although it too, involves the manipulation of one or more independent variables under as carefully controlled conditions as the situation will permit (p. 176)". Cook and Campbell (1979) make a distinction between internal validity and external validity. Cook and Campbell use the term *internal validity* to refer to "the validity with which statements can be made about whether there is a causal relationship from one variable to another (p. 38)". They use the term *external validity* to refer to "the validity with which conclusions are drawn about the generalizability of a causal relationship to and across populations of persons, settings, and times (p. 39)". Whereas the laboratory experiment is generally believed to be more internally valid, the field experiment is typically more externally valid. We opted for the *experimental laboratory approach* for this research project because it had certain advantages:

- a high level of internal validity
- it could be run on a low budget
- it was not so time-consuming thus allowing for more observations
- it allowed the random assignment of individuals to treatments (which is more difficult in a field setting).

As already explained, the external validity might prove to be a weak point in the experimental laboratory approach. To maximize the external validity an experimental environment had to be chosen which corresponded as closely as possible to a real-life situation. We opted for a marketing strategy simulation game. Larréché (1987) mentions a number of the advantages of simulations (games) when used as an experimental setting for research: (1) decisions are made successively over several simulated periods, allowing an explicit consideration of the time dimension, (2) measures of performance are readily available, (3) experimental conditions can be controlled relatively easily, and (4) participants are motivated by the dynamic and competitive elements of the situation. However, these advantages only apply if the simulation is sufficiently realistic and the decisions and the environment in which they are made represent real-world situations. We chose the MARKSTRAT environment (Larréché and Gatignon, 1990). Research by Kinnear and Klammer (1987) shows that managers, working in diverse industries, believe that MARKSTRAT does reflect a real marketing environment useful for teaching and research. Furthermore, MARKSTRAT has been widely used for research purposes already. A number of studies conducted in the MARKSTRAT environment are described in Appendix One. Based on this research and on the research reported above, we conclude that MARKSTRAT is a game which shows a good level of external validity by reflecting a realistic marketplace. Therefore, MARKSTRAT can be conceived of as suited to the purpose of being an experimental setting for research on the effectiveness of marketing management support systems.

In this chapter a description is given of the study's design. We start, in § 3.2, with a description of the MARKSTRAT environment in order to explain the decision problems facing the subjects in the experiment. Three experiments were conducted to answer the three research questions formulated in Chapter One. In § 3.3, the three experimental designs are described. In § 3.4, the operationalization of the variables from the research model is described. Finally, in § 3.5, the experimental procedure is described.

3.2 THE MARKSTRAT ENVIRONMENT

Based on Gatignon (1987) the MARKSTRAT game's main features can be summarized as follows (for a complete description see Gatignon (1987) and Larréché and Gatignon (1990)). MARKSTRAT provides an environment in which a fixed number of firms (five) compete, using a large set of marketing instruments in markets with heterogeneous consumer preferences. The marketing-mix variables (advertising expenditures, prices, salesforce expenditures) are the tools with which to implement a marketing strategy. The complex, competitive and demand dynamics in MARKSTRAT, correspond to realistic, long-term market mechanisms.

The product class in MARKSTRAT is a consumer-durable comparable to electronic entertainment products. The market is segmented. Each consumer segment has distinct preferences and these preferences change over time to some degree. Three channels of distribution carry the firms' brands. Their sizes are different, and different consumer segments shop in different channels. The structure of the distribution system cannot be altered.

The mathematical model behind the market mechanism in the MARKSTRAT world consists of a number of nonlinear relationships between the variables. A necessary condition for buying a given brand is that consumers are aware of the product and its attribute values. Purchase intentions are determined by the consumers' perceptions of the various brands relative to the ideal brand of the segment. Market share is a function of intentions to purchase, given that the product is available and that the competitive products are available in sufficient quantities to satisfy the demand of consumers who prefer them. This availability is, from a marketing point of view, determined by the distribution network, which is a function of the sales force size in the appropriate channels of distribution. This availability also assumes that the brands have been manufactured in sufficient quantity.

Larréché (1987) distinguishes three levels in the conceptual scope of a marketing simulation game: marketing management, marketing strategy and corporate strategy. The complete MARKSTRAT game is a marketing strategy game. In this complete MARKSTRAT version, decision-makers have the opportunity to change the value of attributes of existing products and to develop new products. In our study, however, a stripped-down version of MARKSTRAT is used. In the stripped-down version it is not possible to change products or to develop new products. This means that the simulation game, used in this research, is a marketing management simulation which deals only with marketing-mix decisions for an existing product portfolio. These decisions can be categorized as management control decisions (Anthony, 1965).

The subjects in the experiment adopt the role of marketing decision-makers in the MARKSTRAT world. Specifically they are the marketing decision-makers of company 2 in the MARKSTRAT world. This company is marketing two brands called SEMI and SELF. The ultimate objective given to the decision-makers is to maximize the total market share of their company. They are told, however, that "their profits are also very important because the profit in one period determines the marketing budget in the next".

To obtain a certain market share the decision-makers have to make decisions concerning:

- the advertising budget;
- the percentage of the advertising budget allocated to advertising research;
- the price;
- the quantity of products to be produced; and
- the position in the perceptual space where they want their product to be positioned.

These decisions have to be made for both brands: SEMI and SELF. Furthermore, in each period decisions have to be made on the sales force size and the allocation of this sales force over the distribution channels. The market share obtained for both brands is a function of their own decisions, decisions of competitors and environmental factors in the MARKSTRAT world.

Subjects have to make their decisions for four consecutive periods. At the beginning of each period decision-makers receive computer printouts including information on:

- financial results and financial situation;
- performance in the market;
- general economic conditions;
- consumer habits and intentions;
- market size forecasts;
- competitors' actions; and
- a perceptual map.

This information is available for the decision-makers each period and is free.

In addition to the company of the decision-maker, four other competitive companies are active in the industry too. Each of these four companies is marketing two brands. These four companies are phantom companies. All decisions for these phantom companies are developed by the experimenter in advance. The strategies for the competing brands are described in detail in Appendix One. The competitive behaviour can be characterized as rational and is in conformity with the principles of the Growth-Share Matrix of the Boston Consulting Group (Aaker, 1992): products with profit-potential should be provided with more marketing support than less promising brands

which should be treated as cash-cows. For each of the eight competing brands an assessment was given to show whether marketing support was promising or whether "milking the brand" out was more sensible. Based on these findings, for each of the four companies strategies were developed for each of the four consecutive periods.

The idea of phantom companies has also been used by Lucas and Nielsen (1980). It means that each participating firm faces the same starting situation and the same competitors. Thus, the subjects do not compete with each other. In this way the performance of one subject is independent of other subjects. This is not communicated to the respondents. The most important advantage of the phantom companies' approach is that the results of the subjects are comparable.

3.3 DESCRIPTION OF THE EXPERIMENTS

In Table 3-1 the experimental design is shown. In our study we systematically manipulated the type of MMSS the subjects had at their disposal (no MMSS, high-quality MDSS, medium-quality MDSS and MKBS), and the amount of time-pressure (low time-pressure vs. high time-pressure) the decision-makers had to operate under. Furthermore, the decision-makers were categorized according to their marketing decision-making experience (experienced vs. inexperienced). This resulted in the design as described in Table 3-1.

As shown in Table 3-1, the data studied covered twelve not sixteen experimental groups. The effects of the medium-quality MDSS and the MKBS were studied only for inexperienced decision-makers. This was done because it proved to be very time consuming to recruit experienced marketing decision-makers. Since we did not expect the direction of the effects of both the medium-quality MDSS and the MKBS to differ from the effects of the high-quality MDSS for experienced decision-makers, this lack of knowledge in the four groups was not conceived of as a serious problem.

Table 3-1 Experimental Design

		Marketing Decision-Making Experience			
		Inexperienced		Experienced	
		Time-Pressure		***Time-Pressure***	
		Low	High	Low	High
Marketing Management Support System	NO MMSS	Group 1 (n=20)	Group 2 (n=20)	Group 5 (n=20)	Group 6 (n=20)
	MDSS high-quality	Group 3 (n=20)	Group 4 (n=20)	Group 7 (n=20)	Group 8 (n=20)
	MDSS medium-quality	Group 9 (n=20)	Group 10 (n=20)	***	***
	MKBS	Group 11 (n=20)	Group 12 (n=20)	***	***

As already described in Chapter Two, in order to answer the three research questions formulated in Chapter One, we analysed three specific contrasts between the four levels of the MMSS variable. Therefore, for the analysis of the three research questions we split up the total experimental design (Table 3-1) in three (sub)experiments. In Experiment 1 the data of groups 1-8 are analysed. In Experiment 2 the data of groups 1-4, 9 and 10 are analysed. Finally, in Experiment 3, the data of groups 1, 2, 11 and 12 are analysed.

In this section the three experiments are described. For each experiment we describe the specific dependent variables which were measured in the different experimental groups, the experimental variables (and their levels), and the independent variables which were treated as covariates. Furthermore, the results of checks on the independency of the independent variables and on the successfulness of the time-pressure manipulation are reported. In the next section (§ 3.4) the operationalization of the variables is described.

3.3.1 Experiment 1: Effects of a Marketing Decision Support System

To investigate whether the use of an MDSS influences the performance of marketing decision-makers and if so, under which conditions, we study

whether the use of the MDSS increases the market share performance (SHARE), whether it costs extra decision-making time (DMTIME), which factors influence the number of simulations made with the MDSS (SIMUL), whether the use of the MDSS influences the decision-confidence (CONFIDENCE), and which factors influence the perceived usefulness of the MDSS (USEFUL).

Three independent variables were treated as experimental variables:

- Use of an MDSS (HQMD) was systematically manipulated as *Marketing Management Support System* variable. This variable had two levels, i.e. not using any MMSS vs. using an MDSS (high-quality).
- Marketing decision-makers were categorized according to their marketing decision-making experience (EXPE) as *Marketing Decision-Maker* variable. This variable had two levels, i.e. inexperienced vs. experienced.
- Time-pressure (TIPR) was systematically manipulated as *Decision-Environment* variable. This variable had two levels, i.e. low time-pressure vs. high time-pressure.

Furthermore, two independent variables were treated as covariates:

- Field dependence (FIDE) as *Marketing Decision-Maker* variable.
- Attitude towards MDSS (ATTI) as *Marketing Decision-Maker* variable.

In Table 3-2 the design of the first experiment is presented schematically. It contains eight groups. This table can be read as follows: the twenty decision-makers in group 7 were decision-makers who used the high-quality MDSS, were experienced in making marketing decisions and operated under low time-pressure. For these decision-makers we measured the market share (SHARE) four times, the amount of decision-making time (DMTIME) four times, and also the number of simulations they made with the high-quality MDSS (SIMUL) four times. Furthermore, the confidence they showed in their decisions (DECO) and the usefulness of the MDSS, as they perceived it (PUMS), were measured twice.

Table 3-2 *Experiment 1 (in parentheses the number of repeated measurements). Total n=160*

		Marketing Decision-Making Experience			
		Inexperienced		Experienced	
		Time-Pressure		***Time-Pressure***	
		Low	High	Low	High
Marketing Management Support System	NO MMSS (control group)	GROUP 1 (n=20) SHARE(4) DMTIME(4) CONFIDENCE(2)	GROUP 2 (n=20) SHARE(4) CONFIDENCE(2)	GROUP 5 (n=20) SHARE(4) DMTIME(4) CONFIDENCE(2)	GROUP 6 (n=20) SHARE(4) CONFIDENCE(2)
	MDSS high-quality	GROUP 3 (n=20) SHARE(4) DMTIME(4) SIMUL(4) CONFIDENCE(2) USEFUL(2)	GROUP 4 (n=20) SHARE(4) SIMUL(4) CONFIDENCE(2) USEFUL(2)	GROUP 7 (n=20) SHARE(4) DMTIME(4) SIMUL(4) CONFIDENCE(2) USEFUL(2)	GROUP 8 (n=20) SHARE(4) SIMUL(4) CONFIDENCE(2) USEFUL(2)

3.3.2 Experiment 2: Effects of the Quality of the Marketing Decision Support System

Experiment 2 was set up to investigate whether the quality of an MDSS influences the performance of a decision-maker, and if so under which conditions. The same dependent variables as in the first experiment were analysed (SHARE, DMTIME, SIMUL, CONFIDENCE, and USEFUL).

Two independent variables were treated as experimental variables:

- Quality of the MDSS (QLMD) was systematically manipulated as *Marketing Management Support System* variable. This variable had three levels, i.e. not using any MMSS, using a medium-quality MDSS and using a high-quality MDSS (this is the same system as used in experiment 1).
- Time-pressure (TIPR) was systematically manipulated as *Decision-Environment* variable. This variable had two levels, i.e. low time-pressure vs. high time-pressure.

Furthermore, as in Experiment 1, field dependence (FIDE) and the attitude towards MDSS-in-general (ATTI) were treated as covariates.

In Table 3-3 the design of the second experiment is presented schematically. The data of the groups not using any MMSS, and the groups using the high-quality MMSS are the same as used in the first experiment (i.e. inexperienced subjects).

Table 3-3 *Experiment 2 (in parentheses the number of repeated measurements). Total n=120.*

		Time-Pressure	
		Low	High
NO MMSS		GROUP 1 (n=20)	GROUP 2 (n=20)
(control group)		SHARE(4) DMTIME(4) CONFIDENCE(2)	SHARE(4) CONFIDENCE(2)
Marketing Management Support System	MDSS medium-quality	GROUP 3 (n=20)	GROUP 4 (n=20)
		SHARE(4) DMTIME(4) SIMUL(4) CONFIDENCE(2) USEFUL(2)	SHARE(4) SIMUL(4) CONFIDENCE(2) USEFUL(2)
	MDSS high-quality	GROUP 5 (n=20)	GROUP 6 (n=20)
		SHARE(4) DMTIME(4) SIMUL(4) CONFIDENCE(2) USEFUL(2)	SHARE(4) SIMUL(4) CONFIDENCE(2) USEFUL(2)

3.3.3 Experiment 3: Effects of a Marketing Knowledge-Based System

Experiment 3 was set up to study whether the use of an MKBS influences the performance of a marketing decision-maker, and if so, under which conditions. The following dependent variables were measured: SHARE, DMTIME, CONFIDENCE and USEFUL.

Two independent variables were treated as experimental variables:

- Use of the MKBS (MKBS) was systematically manipulated as *Marketing Management Support System* variable. This variable had two levels, i.e. not using the MKBS vs. using the MKBS.
- Time-pressure (TIPR) was systematically manipulated as *Decision-Environment* variable. This variable had two levels, i.e. low time-pressure vs. high time-pressure.

Furthermore, again, field dependence (FIDE) and attitude towards MDSS-in-general (ATTI) were treated as covariates.

In Table 3-4 the design of the third experiment is presented schematically. The data of the control group are the same as analysed in the first and in the second experiment.

Table 3-4 Experiment 3 (in parentheses the number of repeated measurements). Total n=80

		Time-Pressure	
		Low	High
Marketing Management Support System	NO MMSS	GROUP 1 (n=20)	GROUP 2 (n=20)
	(control group)	SHARE(4) DMTIME(4) CONFIDENCE(2)	SHARE(4) CONFIDENCE(2)
	MKBS	GROUP 3 (n=20)	GROUP 4 (n=20)
		SHARE(4) DMTIME(4) CONFIDENCE(2) USEFUL(2)	SHARE(4) CONFIDENCE(2) USEFUL(2)

3.3.4 Independency Check

Preferably, the independent variables in the experiment should be orthogonal. By virtue of the design, the experimental factors are independent of one another. However, the two covariates might introduce correlation between the independent variables. Therefore, in this section, for each of the three experiments, we investigate whether the covariates and the experimental factors are independent of one another and whether the covariates are independent.

The checks performed in this section are technical. This means that we will not discuss the operationalization of the variables and the meaning of eventual relationships between these variables. In Section 3.4 the operationalization of the variables is described.

Experiment 1

In Table 3-5 the mean values of FIDE and ATTI are presented. ANOVA for the eight experimental groups shows that the field dependence scores are significantly higher for the experienced marketing decision-makers than for the inexperienced marketing decision-makers *($F=4.75, p=0.031$)*. However, in our study the correlation between EXPE and FIDE is relatively small *($r=0.17$, $p=0.029$)*. The other two experimental factors do not have a significant influence on FIDE.

ANOVA for the eight experimental groups shows that ATTI also differs for the different experimental conditions. Although ATTI is measured before the beginning of the experiment, and should not differ between the experimental conditions, ANOVA shows a slight tendency for subjects in the high time-pressure conditions to show a more positive attitude towards MDSS than decision-makers in the low time-pressure conditions *($F=3.280, p=0.072$)*. The magnitude of the correlation between ATTI and TIPR is small *($r=0.14$, $p=0.069$)*. Analysis shows further that there is no significant correlation *($r=-0.06, p=0.475$)* between the two covariates ATTI and FIDE.

We conclude that between the five independent variables only a few small correlations exist, so no serious multicollinearity problems are present in Experiment 1.

Table 3-5 *Experiment 1: Mean Values of the Covariates and Perception of the amount of Time-Pressure (Standard Deviations in parentheses, each group n=20)*

Upper part of each Cell: FIDE
Middle part of each Cell: ATTI
Lower part of each Cell: PTIPR

		Marketing Decision-Making Experience			
		Inexperienced		Experienced	
		Time-Pressure		***Time-Pressure***	
		Low	High	Low	High
Marketing Management Support System	NO MMSS	GROUP 1 30.16 (13.25)	GROUP 2 25.35 (13.69)	GROUP 5 33.26 (18.31)	GROUP 6 38.14 (20.89)
	(control group)	5.70 (1.05)	6.06 (0.82)	5.66 (0.88)	5.78 (0.87)
		2.80 (0.84)	3.31 (0.63)	2.76 (1.13)	3.44 (0.79)
	MDSS	GROUP 3 32.57 (15.90)	GROUP 4 27.61 (15.18)	GROUP 7 34.34 (24.52)	GROUP 8 35.07 (20.89)
	high-quality	5.57 (0.97)	5.79 (0.80)	5.42 (1.12)	5.76 (0.59)
		3.05 (0.84)	3.65 (0.65)	3.03 (1.19)	3.03 (0.90)

Experiment 2

In Table 3-6 the mean values of FIDE and ATTI are presented. ANOVA for the six experimental groups shows that the field dependence scores are not significantly influenced by one of the experimental factors. As in Experiment 1, ATTI is significantly higher in the high time-pressure conditions than in the low time-pressure conditions *(F=5.85,p=0.017)*. The correlation between ATTI and TIPR is relatively small *(r=0.22,p=0.016)*. Also a small correlation exists between FIDE and ATTI *(r=-0.18,p=0.044)*. Field dependent subjects show a less positive attitude towards MDSS.

Since the correlations are relatively small we conclude that in Experiment 2 no multicollinearity problems are present.

Table 3-6 *Experiment 2: Mean Values of the Covariates and Perception of the amount of Time-Pressure (Standard Deviations in parentheses, each group n=20)*

Upper part of each Cell: FIDE
Middle part of each Cell: ATTI
Lower part of each Cell: PTIPR

		Time-Pressure	
		Low	High
	NO MMSS	GROUP 1 30.16 (13.25)	GROUP 2 25.35 (13.69)
	(control group)	5.70 (1.05)	6.06 (0.82)
		2.80 (0.84)	3.31 (0.63)
Marketing Management Support System	MDSS	GROUP 3	GROUP 4
		26.22 (17.06)	26.47 (8.76)
	medium-quality	5.55 (0.99)	6.14 (0.60)
		2.77 (1.09)	3.51 (0.79)
	MDSS	GROUP 5 32.57 (15.90)	GROUP 6 27.61 (15.18)
	high-quality	5.57 (0.97)	5.79 (0.80)
		3.05 (0.84)	3.65 (0.65)

Experiment 3

In Table 3-7 the mean values of FIDE and ATTI are presented. ANOVA for the four experimental groups shows no significant differences in both FIDE and ATTI between the different experimental conditions. Furthermore the correlation between the covariates ATTI and FIDE is not significant *(r=-0.04, p=0.748)*. From this we conclude that in Experiment 3 no multicollinearity problems exist.

Table 3-7 *Experiment 3: Mean Values of the Covariates and Perception of the amount of Time-Pressure (Standard Deviations in parentheses, each group n=20)*

Upper part of each Cell: FIDE
Middle part of each Cell: ATTI
Lower part of each Cell: PTIPR

		Time-Pressure	
		Low	High
	NO MMSS	GROUP 1 30.16 (13.25)	GROUP 2 25.35 (13.69)
	(control group)	5.70 (1.05)	6.06 (0.82)
Marketing Management		2.80 (0.84)	3.31 (0.63)
Support System	MKBS	GROUP 3 23.45 (16.38)	GROUP 4 28.00 (13.49)
		6.02 (0.69)	5.89 (0.77)
		2.93 (0.99)	3.57 (0.67)

3.3.5 Manipulation Check

A manipulation check had to be conducted for one of the experimental variables (time-pressure). It was checked whether subjects in the two different time-pressure conditions also differed in their perception of the amount of time-pressure. To perform these checks we developed the perceived time-pressure (PTIPR)-scale. This PTIPR-scale was constructed from six, 5-point (strongly disagree / strongly agree) Likert items (see Table 3-8). The scale measured the amount of time-pressure subjects perceived when participating in the experiment. Except for item 3, subjects in the high time-pressure conditions scored significantly higher *($p<0.01$)* on all of the six separate time-pressure perception items, than subjects in the low time-pressure conditions. This means that they perceived more time-pressure than subjects in the low time-pressure conditions. The Cronbach alpha reliability of the scale consisting of these six items was 0.85. Item analysis showed that this coefficient could not be improved considerably by removing any of the items.

Using factor analysis (Kim and Mueller, 1978), a weighted PTIPR-score was constructed from the scores of the subjects on the six items. The PTIPR-factor explained 50% of the total variance in the six items. Using the (factor) scores on this PTIPR-scale we analysed whether the time-pressure manipulation had been successful in each of the three experiments.

Table 3-8 *Time-Pressure Perception Items*
Measured once for 240 experimental subjects
(strongly disagree 1-2-3-4-5 strongly agree)

Item	Low Time Pressure Condition	High Time Pressure Condition
1. The availability of more decision-making time would have made it possible to make better decisions	3.96	4.33
2. I felt rushed when playing MARKSTRAT	2.83	3.33
3. There was insufficient decision-making time to make acceptable decisions	3.14	3.35
4. There was time-pressure	3.58	4.03
5. While playing MARKSTRAT, I had sufficient time to make well-considered decisions	2.78	2.33
6. I had to hurry while playing MARKSTRAT	3.12	3.59
Cronbach α: 0.85		

Experiment 1

In Table 3-5 the mean values of PTIPR for Experiment 1 were presented. Perdue and Summers (1986) state that an adequate analysis of a manipulation check for a given factor within a full-factorial ANOVA model, requires the analysis of the statistical significance of all main and interaction effects, not just the factor corresponding to the manipulation check measure, being analysed. This is why here the time-pressure perception is analysed using the ANOVA model with the main effects of the experimental factors (Table 3-2) and all of their interaction effects.

ANOVA for the experimental groups shows that the time-pressure factor is the only factor which has a significant influence on the time-pressure perception *($F=10.12, p=0.002$)*. Subjects in the high time-pressure conditions perceive more time-pressure than subjects in the low time-pressure conditions. None of the other effects is significant. Based on this result we conclude that the time-pressure manipulation is successful.

Experiment 2

In Table 3-7 the perceptions of the amount of time-pressure (PTIPR) for Experiment 2 were presented. ANOVA shows that the time-pressure factor is the only factor which has a significant influence on PTIPR *($F=16.957$, $p=0.000$)*. Since none of the other effects is significant we conclude that the time-pressure manipulation in the second experiment is also successful.

Experiment 3

In Table 3-8 the perceptions of the amount of time-pressure (PTIPR) for Experiment 3 were presented. Again, ANOVA shows that the time-pressure factor is the only one which significantly influences PTIPR *($F=10.366$, $p=0.002$)*. We conclude that the time-pressure manipulation is also successful in the third experiment.

3.4 OPERATIONALIZATION OF THE VARIABLES IN THE MODEL

This section is concerned with the way the variables from the research model (see Chapter Two) were measured or manipulated. First, the independent variables are described. After this, the operationalization of the dependent variables is described.

3.4.1 Independent Variables

TYPE OF MARKETING MANAGEMENT SUPPORT SYSTEM

The experimental designs, described in Section 3-3, show that four different types of marketing management support were applied (no MMSS, high-quality MDSS, medium-quality MDSS and MKBS). In this section these four levels are described. In Appendix Three some screendumps of the MMSS are presented.

No MMSS (unaided condition)

The decision-makers having no MMSS at all at their disposal, received computer printouts containing financial results and marketing research at the beginning of each of the four periods. These printouts contained information about the financial situation of the company, the performance of the company in the market, general economic conditions, consumer habits and intentions, market size forecasts, advertising and distribution expenditures of competitors and a perceptual map containing the position of all brands and the ideal points of the consumer segments on the two most important attributes. To make the decisions the subjects were provided with paper, pencil and calculator.

High-quality MDSS

The decision-makers operating in the high-quality MDSS condition also had the studies presented on paper at their disposal, as described in the non-MMSS condition. *In addition to* this information presented on paper, decision-makers operating in this condition also had an MDSS at their disposal. The MDSS consisted of both a data base and a model base. The MDSS enabled the decision-makers to investigate the effects of a number of alternative marketing actions by performing "what-if" analyses. To make this possible the MDSS contained a simulation model. Input for the data base of the MDSS in each period were marketing research data, financial data concerning the company and data about general economic conditions. To perform the what-if analyses, the user of the system had to enter the values of the advertising budgets, the percentages of the budgets for advertising research, the prices and the number of salespersons in the different distribution channels for the two brands SEMI and SELF. After entering the value of these "decisions", the MDSS predicted the values of the amount of sales, the net marketing contribution, the brand awareness and the number of distributors for both brand SEMI and brand SELF. The operation of the MDSS is presented schematically in Table 3-9.

Table 3-9 *Operation of the simulation model of the MDSS (Input -> Output)*

INPUT:	• Marketing Research Data • Financial / Economic Data Source: Data Base (updated each MARKSTRAT period)
	• Marketing Decisions (simulation variables) — Advertising Budget (SEMI&SELF) — Percentage Advertising Research (SEMI&SELF) — Price (SEMI&SELF) — Number of Salespersons (Each Channel, 1,2&3) Source: The Marketing Decision-Maker (each simulation)
OUTPUT:	• Forecasts of: — Sales (SEMI&SELF) — Net Marketing Contribution (Total) — Brand Awareness (SEMI&SELF) — Number of Distributors (SEMI&SELF, Channels 1,2&3)

The user of the MDSS could make a number of these simulations in order to help him design an optimal marketing plan.

The MDSS also had the option of presenting graphs for the relationship between advertising expenditures and the brand awareness. In the same

way graphics were created for the relationship between distribution efforts and the number of distributors for a brand.

The simulation model of the MDSS gave good predictions for the diverse phenomena in the market. The mean absolute percentage error (MAPE) in the forecasts of the sales of SEMI and SELF made by the MDSS was 3% (standard deviation 2.6%) for the simulation of 100 representative marketing-mix decisions. We developed an MDSS which showed a MAPE as small as possible[4].

Medium-quality MDSS

The high-quality MDSS described above will probably make better predictions than systems used in real-life settings. Therefore we also investigated the effects of an MDSS showing a larger, and probably more realistic, prediction error. The decision-makers operating in the medium-quality MDSS condition had an MDSS at their disposal which was equal in all respects to the MDSS described above except with respect to the predictive power of the simulation model. The MAPE of the sales forecasts of the medium-quality MDSS was 23% (standard deviation 16%) for the simulation of the very same 100 different marketing-mix programs (3% for the high-quality MDSS) as mentioned above. So the MAPE of the medium-quality MDSS was exactly 20 percentage-points higher than the MAPE of the high-quality MDSS. This was realized by building in an error term in the MDSS.

To our knowledge, not very much is known about the predictive power of marketing models, used in real-life settings. This makes it difficult to assess the degree of reality of the predictive power of the medium-quality MDSS. In the field of time-series models Wheelwright and Makridakis (1985) report the results of a competition in which forecasts for up to 1001 actual time series of major time-series methods were compared. The average MAPE of the twenty-four methods that were evaluated was 22.1%. The medium-quality MDSS used in our study thus showed a MAPE which was comparable with these time-series methods.

MKBS

In addition to the computer printouts, the decision-makers operating in the MKBS condition had a marketing knowledge-based system (MKBS) available. This system was a monitoring and diagnosing system. The MKBS

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4 As part of the original MARKSTRAT-model was secret we were not able to develop an MDSS which made perfect predictions.

assisted the marketing decision-makers by means of qualitative reasoning to systematically analyse the financial and marketing results the decision-makers obtained each period. The system looked for changes in the levels of target variables and when these were present, performed a diagnosis to find the causes of these changes. For this diagnosis, data from the financial and marketing research studies were used. This way the marketing results were directly linked to the decisions made.

For example when the market share of one of the brands decreased the system checked to find out the causes of this decrease. If, for example, the brand awareness of the brand had decreased, this would be interpreted as one of the possible causes of a decrease in the market share. Next the system would search for possible causes of the decrease in brand awareness. In the same way, changes in other variables like the distribution degree could be checked. The MKBS investigated for all decision-variables (advertising expenditures, number of salespeople etc.) whether they were likely to have caused a change in the market share and profit. After having diagnosed the results of the past period, the decision-makers could use the results from the diagnosis for making decisions in the following period.

The marketing knowledge-based system thus supported the decision-makers in the first phase, the *intelligence* phase (Simon, 1977), of the decision-making process whereas the MDSS supported the marketing decision-makers in the *design* and *choice* phase of the decision-making process.

Evaluation of the Marketing Management Support Systems

After the experimental session the participants in the experiment were asked to evaluate the MMSS they had used. In this section we present the results of this evaluation.

The subjects in the various MMSS conditions were asked to rate the user-friendliness of the specific MMSS they had at their disposal on 5-point scales as presented in Table 3-10. In Table 3-10 the mean scores for each type of MMSS on the six scales are presented. Furthermore, we also presented the standard deviations (in parentheses) in the ratings.

The results in Table 3-10 show that the high-quality MDSS was easy to use and the results were easily interpretable. Furthermore, it was nice, pleasant, fun and not difficult to work with. This means that the characteristics of the high-quality MDSS did not entail any barriers to its use.

Table 3-10 Evaluation of the MMSS, on the scale
Strongly disagree 1-2-3-4-5 Strongly agree

Item	MDSS High-Quality	MDSS Medium-Quality	MKBS
1. The MMSS was easy to use	4.05 (0.94)	4.35 (0.77)	3.85 (1.08)
2. The results of the MMSS were easily interpretable	3.84 (0.89)	3.63 (1.01)	3.85 (0.80)
3. It was fun to work with the MMSS	4.34 (0.64)	4.18 (0.59)	3.93 (1.00)
4. It was difficult to work with the MMSS	2.04 (0.95)	1.80 (0.72)	1.85 (0.58)
5. Working with the MMSS was a nice activity	4.23 (0.62)	4.08 (0.57)	3.83 (0.90)
6. Working with the MMSS was very pleasant	3.90 (0.63)	3.80 (0.69)	3.48 (0.99)

The medium-quality MDSS was also easy to use, its results were easily interpretable, it was nice, pleasant, fun and not difficult to work with. This means that the characteristics of the medium-quality MDSS also did not have any user drawbacks either. Thus, no major differences thus appeared in the evaluations of the medium and the high-quality MDSS. This is what we expected, since the interfaces of the two systems were exactly the same.

Finally, the MKBS, was also evaluated. It can be concluded that the MKBS was also easy to use and the results were easily interpretable. Furthermore, it was fun, nice, pleasant and not difficult to work with. This system did not have any user drawbacks either. Overall, when compared with the medium and the high-quality MDSS, the subjects were a little less positive. They evaluated working with the MKBS as significantly *($p<0.05$)* less fun, a less nice activity and less pleasant when compared to both the medium and the high-quality MDSS. A possible explanation for this may be the fact that the MKBS took more processing time to perform its analyses than the two MDSS.

For each of the three MMSS, the percentage of users giving the MMSS extremely negative scores most of the time was 0%. Only in the case of the MKBS was this percentage 5% (two users) for the first and the sixth item.

Overall, we can conclude that subjects did not seem to encounter any problems in working with each of the three MMSS. The MKBS was evaluated less positively, when compared to the MDSS, with respect to items concerning the pleasure / fun of working with it. However, in an absolute sense it was still evaluated positively.

Marketing Decision-Maker

Three marketing decision-maker variables were studied: marketing decision-making experience, field dependence and the attitude towards MDSS-in-general.

Marketing Decision-Making Experience (EXPE)

EXPE was treated as an experimental variable. Subjects were categorized according to their marketing decision-making experience. Two groups of decision-makers were created. One group was labelled as the "inexperienced marketing decision-makers". This group consisted of master level students (average age: 22.2 years) in business administration or economics. The subjects in this group did not have experience in a marketing function. The other group was labelled as the "experienced marketing decision-makers". This group consisted of professional marketing decision-makers. Their average number of years of experience in a marketing function was 7.9 years. The characteristics of the subjects are described in more detail in Section 3.5.1.

Field Dependence (FIDE)

FIDE was treated as covariate and has been measured by means of the Embedded Figures Test (Witkin et al., 1971). This test consists of twelve figures. The score on this test is measured as the time, in seconds, a subject needs to find a simple, embedded figure in a complex figure. Twelve of such figures are presented to a subject. The final score is the average solution time. Subjects who used a small amount of time can be conceived of as field independent (analytical) subjects, while subjects who needed a larger amount of time are classified as field dependent (non-analytical). Witkin et al. (1971) report a large number of studies in which the Embedded Figures Test has been used. They also report that it showed a satisfactory reliability level. Reliabilities (odd-even and test-retest) are reported which vary between 0.61 and 0.92. With respect to the validity of the Embedded Figures Test, Witkin et al. (1971), whose findings are based on a large number of studies, state that performance in the Embedded Figures Test is related to performance in a variety of other perceptual tests which involve the ability to overcome an embedding context and to perform in a variety of intellectual tasks which involve the same ability. Furthermore, they report a number of