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## FACTOR IDENTIFICATION - AN ANALYSIS OF BUYER BEHAVIOUR DURING THE ACQUISITION OF AN ADVANCED MECHANIZED IRRIGATION SYSTEM

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### Abstract

The article deals with consumer (farming) purchasing behaviour in the advanced mechanized irrigation industry. The consumer decision-making model by Engel-Kollat-Blackwell was used as a basis for the theoretical research, and principal factor analysis was the statistical technique employed to analyse the data. Ten factors (explaining an extremely high cumulative variance of 96.8 per cent) were identified from the rotated factor matrix, and ranked in order of importance. The first five factors, which is considered to be the most important factors (explaining a cumulative variance of 71.1 per cent) were labelled as "Financial planning", "Managerial aspects", "Environmental concerns", "Design aspects" and "Production potential". The five factors which is regarded as not so important were labelled "Return on investment", "Operational qualities", "Dealer orientation", "Service qualities" and "Past experience". Three major groups could benefit greatly from understanding buying behaviour within the advanced mechanized irrigation industry. Firstly, agricultural economists, financial institutions and other advice rendering institutions would be able to increase the quality of their services to potential buyers (farmers). Secondly, farmers would be able to identify the pitfalls within their own reasoning when they consider the acquisition of an advanced mechanized irrigation system, while thirdly, the marketers of these systems would be able to increase the productivity of their sales personnel if they concentrate their sales activities on the more important criteria identified within this article.

### Uittreksel

Die artikel handel oor verbruikerskoopgedrag in die gevorderde gemeganiseerde besproeiingsindustrie. Die verbruikersbesluitnemersmodel van Engel-Kollat-Blackwell is gebruik as teoretiese basis. Die data is met faktor-analise ontleed. Tien faktore is geïdentifiseer en geplaas in volgorde van belangrikheid. Die faktore verklaar 'n kumulatiewe variansie van 96,8 persent. Die eerste vyf faktore naamlik: "Finansiële beplanning", "Bestuur", "Omgewingsveranderlikes", "Ontwerp" en "Produksiepotensiaal" word as die belangrikste faktore beskou en verklaar 'n kumulatiewe variansie van 71,1 persent. Drie groepe kan voordeel trek uit die beskikbaarheid van inligting wat verbruikerskoopgedrag in die gevorderde gemeganiseerde besproeiingsindustrie beskryf. Eerstens behoort landbou-ekonomie, finansiële instellings en ander verskaffers van advies in staat te wees om die kwaliteit van hul dienste aan voornemende kopers (boere) te verbeter. Tweedens behoort dit boere te bevoordeel in hul besluitneming aangaande die aankoop van hierdie besproeiingsstelsels. Derdens behoort dit die bemerkers van die besproeiingstelsels in staat te stel om die produktiwiteit van hul verkoops personeel te verhoog.

### 1. Introduction

In the Eastern Cape, the completion of the Orange-Fish river tunnel provided a number of traditional Karoo farmers the opportunity to irrigate. This development of new irrigation areas proved to be revolutionary in the context of traditional extensive farming. By entering the field of mechanized agricultural development, the farmer not only moves away from traditional approaches, but also encounters the concept of small-scale agricultural growth and development and the substitution of machines for human labour.

Advanced mechanized irrigation systems consist mainly of centre pivot and linear systems and apart from their main function of watering crops, have a vast number of features and safety devices. Each system is designed and customized for a particular consumer.

For example, a recent study (Scheepers, 1987:12-23) following Van Heerden (1986), indicated that it is impossible to grow maize in the Cradock area if the irrigation system cannot supply 12 millimetre of water in 24 hours. The maize will suffer drought-tension, thus defeating the object of investing in a very expensive watering system. Farmers should, therefore, be alerted to the different product attributes and the performance levels required for specific crops before signing a purchase contract.

This calls for an extensive study of consumer buying behaviour to determine how participants in the advanced mechanized irrigation industry behave (Bisschoff, 1989)

### 2. Problem definition

The decision to purchase expensive capital equipment is frequently a source of intense anxiety to prospective buyers, especially if the equipment is technically sophisticated. Since buyers often have limited knowledge of the criteria for evaluating the various product alternatives, they normally have to conduct an in-depth pre-purchase information search. The proposed purchase of a mechanized irrigation system by farmers wishing to improve the productivity of their farming operations usually involves extremely complex purchasing decisions.

### 3. Theoretical structure

Consumer buying behaviour is based on the behavioural research conducted by the consumer behavioural researchers Engel, Kollat and Blackwell (in Runyon and Stewart, 1987:707). The refined research by Engel, Kollat and Miniard (1986), and those of other researchers on the Engel-Kollat-Blackwell consumer decision-making model, were integrated in order to incorporate the latest developments in consumer decision-making.

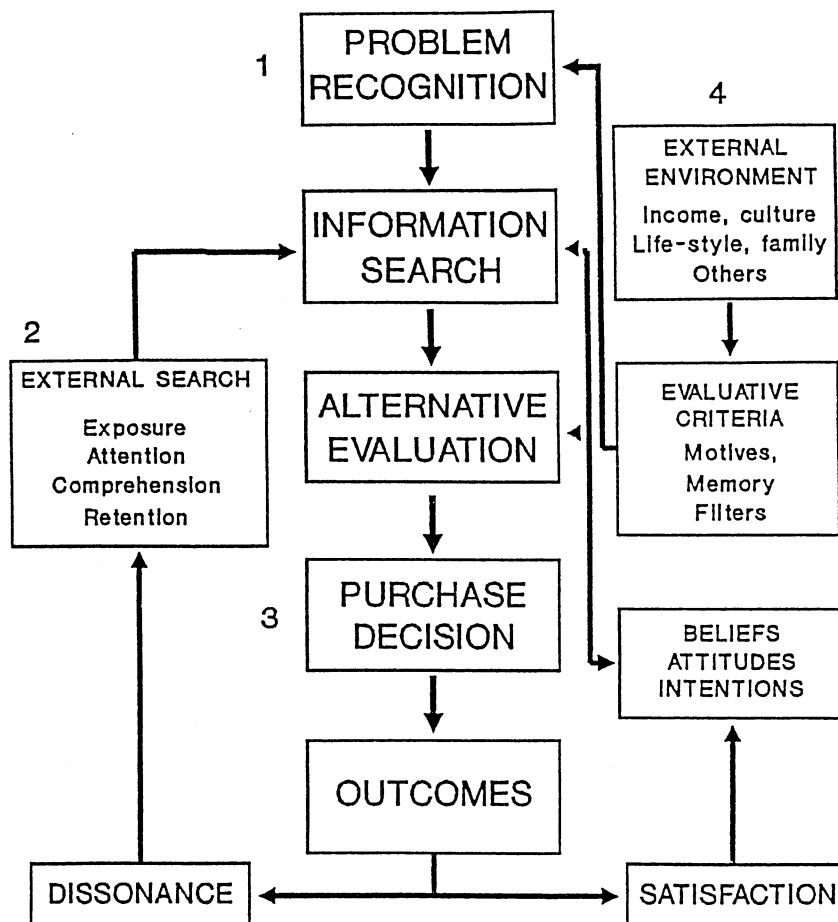


Figure 1: Consumer decision-making  
Adapted from Runyon and Stewart (1987:707)

Consumer decision-making models are useful in that they provide a map of reality; the usefulness of a model lies in the extent to which it enables one to predict behaviour or outcomes successfully. According to Engel, Kollat and Miniard (1986:35) these models all share the following characteristics:

- they provide a frame of reference for research;
- they enable researchers to integrate research findings into a meaningful whole;
- they are useful for theory construction; and
- they provide explanations for the performance of a system.

The Engel-Kollat-Blackwell model of consumer decision-making (depicted in Figure 1) is designed to clarify the basic relationships between the various important areas of knowledge regarding consumer behaviour. Runyon and Stewart (1987:706) state that the model consists of four basic sections: (1) the central control decision stages, (2) information processing, (3) the decision process, and (4) external environmental variables which all influence the decision-making process. These stages are all numbered in Figure 1.

Clearly the governing component of the decision-making model is the central control unit (Runyon and Stewart, 1987:706). The complexity of this stage is illustrated by the fact that conscious as well as unconscious processes operate simultaneously to perform its two major functions set by the central control unit:

- incorporating external stimuli into the decision-making model; and
- initiating and monitoring of the decision-making process.

The information processing component of the Engel-Kollat-Blackwell model includes the filtering process of external stimuli by a component of the central control unit before they are actually admitted to consciousness. There are four stages in the processing of information by the consumer:

- exposure to external stimuli;
- attention, when consumers admit the external stimuli into their conscious awareness;

- comprehension or understanding of the stimuli to which consumers are being exposed, translating the stimuli into information; and
- retention, the process by which consumers store the information in their memory.

The external variables in the environment are many and varied, ranging from physical factors, such as income, to social factors such as culture, social class and family structure.

#### 4. Methodology

The sampling frame consists of farmers in the North-Eastern Cape who purchased mechanized irrigation systems between June 1984 (date of first water rights allocation) and December 1988. Simple random sampling was employed to select the respondents for the research. Forty-eight farmers agreed to participate.

In a pilot study personal in-depth interviews were conducted with fifteen selected farmers to determine the evaluation criteria they had employed when purchasing a mechanized irrigation system. The evaluation criteria identified by the focus group were listed and used to compile a structured questionnaire which was presented to the sample. During the pilot study sixty evaluation criteria were found to be important, and the five key factors were identified by means of factor analysis. Using this information, the researchers compiled a refined questionnaire discarding insignificant evaluation criteria. The study therefore represents an in-depth analysis of the five most important criteria (extracted from the pilot study), and their influence on consumer buying behaviour during the purchase of an advanced mechanized irrigation system. In the structured questionnaire the respondents had to record their responses on a seven point Likert scale to indicate the importance of each evaluative criterion in their purchasing decision.

Personal interviews were conducted with the farmers to ensure that information required in the questionnaire was recorded accurately. Firstly, the relative importance of the evaluative criteria were determined by calculating mean scores and standard deviations for each evaluative criterion.

Secondly, the data were subjected to factor analysis to determine the factors underlying the purchasing decision. It was anticipated that such an analysis would reduce the multiple evaluation criteria and promote understanding of the important factors which should be considered prior to purchasing a mechanized irrigation system.

All analyses were performed with the aid of the mainframe computer software, "Statistical Analysis System".

#### 5. Empirical results

Factor analysis requires some judgement on the part of the researcher in labelling the individual factors. Obviously this introduces a measure of subjectivity to the interpretation of a factor analysis, which by nature is a difficult task. Interpretation of factors calls for a decision on which factor loadings are to be considered and which not. This is reflected by the magnitude of the factor loadings. A factor loading of 0.30 is considered significant, loadings of 0.40 are considered important, and loadings of 0.50 and higher are generally regarded as very significant for interpretative purposes (Hair, Anderson and Tatham, 1984:249). Since this study produced relatively high factor loadings, only evaluation criteria of 0.45 and higher were used to identify the ten factors. These ten factors identified by the preceding analysis were interpreted and then labelled.

- Factor 1 - Financial planning
- Factor 2 - Managerial aspects
- Factor 3 - Environmental concerns
- Factor 4 - Design aspects
- Factor 5 - Production potential of an irrigation system

- Factor 6 - Return on investment
- Factor 7 - Operational qualities
- Factor 8 - Dealer orientation
- Factor 9 - Service qualities
- Factor 10 - Past experience

Factor 1 relates to financial planning, suggesting that future financial implications are the most important factor when considering the acquisition of a mechanized irrigation system. Eight of the forty-eight statements loaded heavily, with the lowest loading at 0.63 which is a significantly high loading, onto Factor 1 (explains 23.6 per cent of the total cumulative variance). Consumers of mechanized irrigation systems perceive "Financial planning" to a large extent as the possible future costs of the irrigation system, and to a lesser extent as future payments and incomes.

Factor 2 declares 14.9 per cent of the total variance explained, and is concerned with management, thus labelled "Managerial aspects". Four statements load heavily on this factor, and especially the statement relating to the accuracy of water management, should be mentioned (a loading of 0.93 was recorded). The other three statements relate to advice from the sales personnel and agricultural bodies regarding managerial aspects of the irrigation system. Clearly, the effect on labour and other fields of productivity plays an important role in deciding which irrigation system should be bought.

Factor 3 is labelled as "Environmental aspects", showing that the consumer also regards these evaluative criteria as relevant to the purchase behaviour. A variance of 12.1 per cent is explained, and this factor consists of six statements. Four of these statements relate to the soil and irrigation water qualities. The other two statements relate to the environment's effects on the irrigation system, and also the supplementary products in mechanized irrigation which could be used in certain areas.

Factor 4 is concerned with the design of the system, and therefore labelled as "Design aspects". Once again, each supplier stocks a differently designed system, and therefore different dealers are tied to the specific design related decisions. All six of the statements are directly related to the different design aspects, and how these different designs could be implemented to suit individual needs and requirements. Factor 4 explains 10.9 per cent of the total variance explained.

Factor 5 relates to the irrigation system's performance, showing that consumers regard this aspect as vital to the purchasing decision. Four statements load heavily on Factor 5, which explains a total variance of 9.6 per cent. Special reference to the statement which recorded perceptions regarding the irrigation system's watering capacity per twenty four hour cycle, should be made as this statement loaded a high value of 0.81. The other three statements show that the area (hectare) covered by the irrigation system, the system's productive working-time, and the effect of an infra-structure on production potential, are also considered to be important in consumer buying behaviour of the mechanized irrigation system. Factor 5 was thus labelled as "Production potential of an irrigation system".

Factor 6 also relates to the financial scenario, but is more concerned with the possible outcome of the investment, thus signifying financial success or trauma. Possible outcomes are closely related to the cost structure of the irrigation system. Five of the six statements loading heavily on Factor 6 relate to the running cost of the system. This factor, which declares 6.9 per cent of the explained variance, is therefore labelled as "Return on investment".

Factor 7 was labelled as "Operational qualities", indicating that the consumer also considers these aspects as important when engaging into buying behavior. Four statements load heavily onto Factor 7 which explains 6.2 per cent of the total variance. Three of these statements relate to different features used in the operation of the irrigation system, while the fourth, relating to the ease of operation, correlates negatively with the other

statements. Thus if the slope of the land which is irrigated increases, the ease of operation declines. An inverse functional relationship therefore exists between the ease of operation and operational qualities of the irrigation system.

Factor 8 implies that the aspect of dealer orientation also contributes largely (explaining 5.4 per cent of the total variance) to the purchase behaviour when considering a mechanized irrigation system. Seven statements load heavily onto Factor 8, with two of these relating to after sales service. The other five relate to the functional design (each supplier has its own unique design) and to the dealer's expertise (established through independent engineers).

With factors 9 and 10 the service and past of the dealer are considered and these factors are labelled as "Service qualities", and "Past experiences". These factors explain 3.7 per cent and 3.5 per cent of the total variance respectively. Two statements load heavily onto Factor 9, while only one statement loads onto Factor 10. Both the statements under Factor 9 relate directly to the service supplied by the dealer, with punctual delivery perceived as very important (loading of 0.91). The statement loading onto Factor 10 (a high loading of 0.91) also relates directly to past experiences with the dealer.

The various factors contributed to explain a cumulative variance of 96.8 per cent which, by any standard, can be regarded as extremely satisfactory. The individual and cumulative variance of all the factors are presented in Table 1. Table 1 highlights the fact that the contribution of factors to the explanation of the variance declines. Factor 1, therefore, declares a larger part of the explained variance than any other factor, while Factor 10 proportionally declares the least.

#### 6. Conclusion and recommendation

A centre pivot irrigation system is a durable item, and may well be one of the most expensive products an irrigation farmer acquires. A thorough evaluation is therefore required prior to the purchase.

Forty-eight evaluation criteria were selected with a structured questionnaire, which consumers had to complete during personal interviews. In sampling, only farmers who already owned a mechanized irrigation system were considered.

Table 1: Factor contribution to explanation of variance

Factor labels	Variance explained %	Cumulative variance explained %
Financial planning	23.6	23.6
Managerial aspects	14.9	38.5
Environmental concerns	12.1	50.6
Design aspects	10.9	61.5
Production potentials	9.6	71.1
Return on investment	6.9	78.0
Operational qualities	6.2	84.2
Dealer orientation	5.4	89.6
Service qualities	3.7	93.3
Past experience	3.5	96.8

The farmers' perceptions were recorded on a seven point Likert scale, on which a factor analysis was performed. Ten factors were identified, declaring a cumulative variance of 96.8 per cent. The cut-off point was set at a factor loading of 0.45, and evaluation criteria with loadings below the cut-off point were not included in the interpretation of the factor analysis.

The identified factors provide a simple framework which can be used as a guideline by different marketing institutions in the irrigation industry to develop strategies for market segmentation, promotion, positioning and the training of sales personnel. This simplification of the initial set of data set certainly reduces the number of evaluation criteria, creating a more concise and manageable framework which can help consumers to understand decision-making on the purchase of advanced mechanized irrigation systems. One would like to see marketers as well as consumers of durable capital products making use of such analysis.

It is significant that the contributions of the different factors to the explanation of the variance decreases, factor 1 being the most important and factor 10 the least important. It is recommended that marketers of mechanized irrigation systems attend to factor 1 first, as this factor is the farmers' main consideration during the buying process. Secondly, by proceeding from the factors explaining the most variance to those explaining less, the marketer will ensure productivity by sales personnel, since the considerations are dealt with in order of priority.

Finally, by greater dealing with the factors on an individual and on a group basis, marketers should be able to comprehend the market in the advanced mechanized irrigation industry better, and should therefore be able to optimize their sales efforts.

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