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DIFFERENCES IN PERCEPTIONS AND EVALUATION CRITERIA AMONG GROUPS INFLUENCING INDUSTRIAL BUYING DECISIONS

Jean-Marie Choffray
Ecole Superieure des Sciences Economiques et Commerciales, Paris

and

Gary L. Lilien
Massachusetts Institute of Technology

Organizational buying behavior is more complex than consumer buying behavior. Organizations typically involve several individuals in purchasing decisions. These individuals represent different functions within the organization and play the roles of users, influencers, buyers, deciders and gatekeepers.

Evidence suggests that participants in industrial purchasing decisions utilize a number of more personal or non-rational as well as rational criteria in selecting products and services [Sheth 1976]. It is, therefore, important to investigate the differences in perception and evaluation criteria among groups influencing buying decisions. The measurement of these differences provides new input for product positioning and for communications strategies, addressing the needs of these different groups. This paper provides a non-technical overview of a measurement and analysis methodology aimed at treating these group differences and using the results to develop marketing strategies.

THE PROBLEM IN PERSPECTIVE

The adoption process in industrial markets has not been studied as systematically as in consumer markets. In the latter several comprehensive methodologies have been developed to assess consumer response to product innovation [Hauser and Urban 1976; Urban 1975]. On the industrial side Choffray and Lilien [1976] proposed a conceptual framework for analyzing the industrial adoption process. That framework identified the major *classes* of variables—environmental, organizational and individual—which affect industrial adoption decisions. Figure 1 outlines that model.

According to Figure 1, environmental constraints and organizational requirements influence the adoption decision process by limiting the number of product alternatives considered that satisfy organizational needs. The resulting set of feasible alternatives is the organization's choice set over which decision participants' perceptions and preferences are defined. Individuals' preferences are then combined into group preferences that lead to organizations' final choices. Choffray and Lilien [1976] developed some analytical models of the group selection of a specific alternative from a firm's feasible set. Choffray [1977] addressed the question of segment identification of organizations which are homogeneous in the structure of their adoption process. This paper is concerned with the third element of this structure, the measurement of how groups of decision participants differ in the way they perceive and evaluate industrial products.

PRODUCT PERCEPTIONS AND EVALUATION CRITERIA: DEFINITIONS

The measurement and analysis methodology described here assumes the existence of an n-dimensional perceptual space common to all buying influencers. Operationally, the perceptual space is defined by a set of salient attributes for the product class under investigation. An individual's perception of a product may then be seen as a vector of coordinates in this space and is provided by his rating of the product on the corresponding set of attribute scales.

When forming judgments about product alternatives, however, it is not likely that individuals consider all these attributes independently and simultaneously. Rather, it is reasonable to assume that individuals organize these attributes into a smaller set of higher order evaluation criteria. The evaluation space common to a group of individuals is then an m-dimensional subspace ($m < n$) that reflects the way individuals structure

Figure 1

CONCEPTUAL MODEL OF THE INDUSTRIAL ADOPTION PROCESS

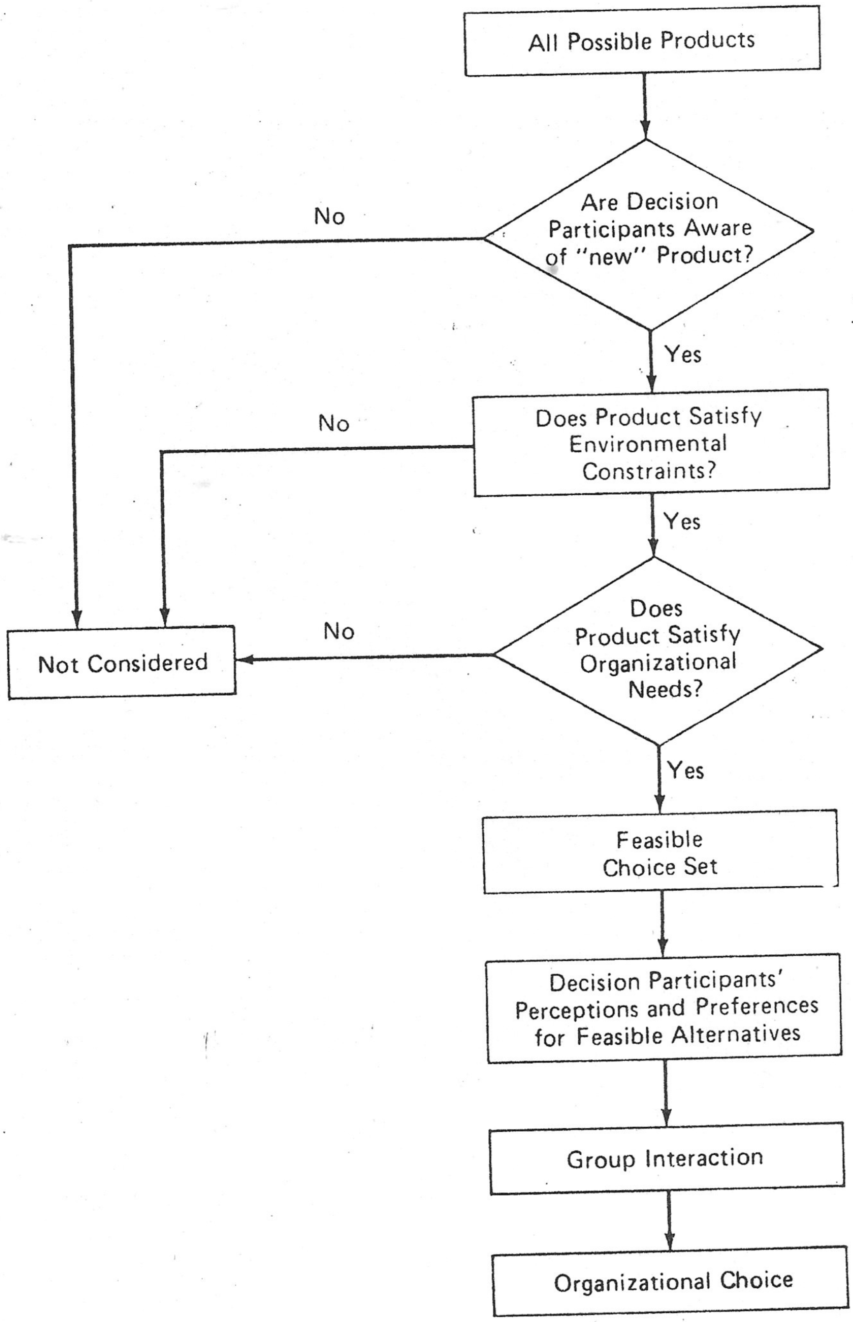


Figure 2

CONCEPT STATEMENT FOR AN ABSORPTION INDUSTRIAL COOLING SYSTEM (ABSAIR)

ABSAIR consists of an absorption chiller, a boiler, piping, pumps and control equipment.

In order to provide cooling, an absorption chiller utilizes a refrigerant (e.g. water) and an absorbent (e.g. lithium bromide) in conjunction with an evaporator, absorber, generator and condenser as diagrammed below. In the evaporator, the refrigerant, in a vacuum, is vaporized by a sprayer. As it evaporates, the refrigerant absorbs heat from the water that is used to cool the building. The refrigerant vapor is then absorbed by the solution in the absorber. The resulting solution is heated in the generator to drive off the refrigerant. At the condenser, the refrigerant vapor condenses and rejects heat to the environment. The refrigerant then returns to the evaporator to start the cycle again.

The boiler uses oil, natural gas or electricity for power. The system can also be driven by commercially-produced steam. The absorption chiller is then independent of the heating system unless both use a common boiler.

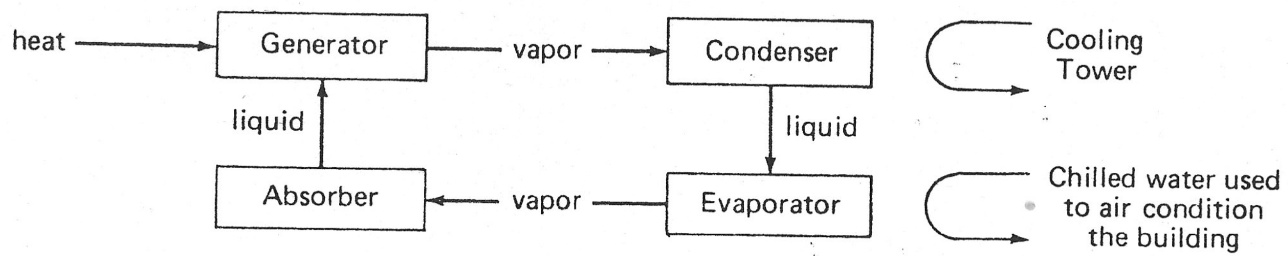
The absorption chiller may be located on the roof or within a mechanical space in the building. Maintenance costs for ABSAIR are approximately 20 percent lower than those of compressor a/c systems. It is less efficient than compression a/c systems in that to cool a given load, ABSAIR requires between 15-20 percent more energy. The absorption chiller has a longer life expectancy than the other a/c systems, so ABSAIR's economic life is around 25 years. In addition, as it has almost no moving parts an absorption chiller is relatively quiet and vibration free.

The other elements of ABSAIR: fans, pumps, piping and control equipment are generally the same as those in compressor a/c systems.

The initial investment cost of ABSAIR may be significantly more than for compressor systems. This difference however tends to be reduced as the installation size increases.

ABSAIR appeals to companies who need a large amount of a/c or who use steam for other industrial processes and want to make additional use of that steam. ABSAIR has been typically used by hospitals and pharmaceutical plants where abundant steam exists. Currently, there are between 3,000 and 5,000 of those industrial a/c systems in use.

DESCRIPTION OF AN ABSORPTION CHILLER



basic product attributes. The coordinate axes in that evaluation space approximately span the original perceptual space. We refer to them as the evaluation criteria common to a specific group of individuals. An individual's evaluation of a product may then be seen as a vector of coordinates in this reduced space.

The questions addressed in this paper can then be summarized in the terms above as:

1. How do different groups of decision participants differ in the way they *perceive* each feasible alternative?
2. How do these groups differ in the way they structure basic product attributes, that is, how do they differ in the number and/or composition of their evaluation criteria?

THE MEASUREMENT OF PRODUCT PERCEPTION AND EVALUATION CRITERIA

Three main steps are involved in the development of a measurement instrument to collect information about participants' perceptions of available product alternatives. First, concept statements are developed for each main alternative in the product class. The use of product-concept statements in industrial marketing research at a stage in product development when the product might not yet be developed appears reasonable. Indeed, given the technical nature of many such products and the technical orientation of industrial customers, accurate product descriptions provide a basis for sensible product evaluation. Moreover, this approach has been used with success in consumer markets where individuals are the unit of analysis [Hauser and Urban 1976]. Figure 2 (pp. 200-1) gives a sample of a concept statement for an absorption industrial cooling system.

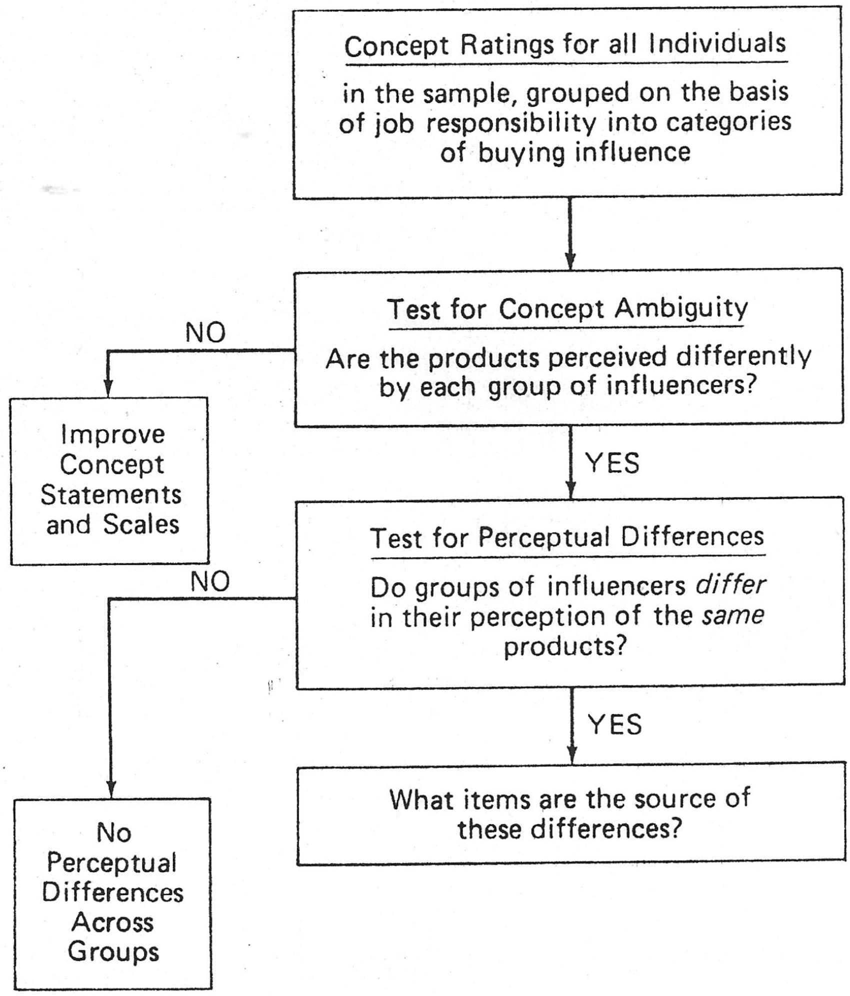
Second, the main attributes of the product class have to be identified. A variety of methods can be used for this purpose including focus group interviews, brain storming, etc. Generally, a large number of attributes are identified. They must then be reduced to a smaller set of non-redundant, salient attributes. Such a list typically includes between 15 and 25 attributes. Finally, for each attribute perceptual scales are developed. Hauser and Urban [1976] suggest Likert scales which measure the extent of agreement with each perceptual proposition. This is the approach used here.

PERCEPTION AND EVALUATION SPACE ANALYSIS METHODOLOGY

Figure 3 outlines the perceptual analysis methodology (a more technical description appears in Choffray and Lilien [1976]). Individuals' perceptions of each alternative are obtained via product concept ratings. Within each group of influencers product perception ambiguity is tested via one-way,

Figure 3

OUTLINE OF PERCEPTUAL ANALYSIS METHODOLOGY



multivariate analysis of variance. Our aim is to test whether the concept statements convey an accurate representation of each product alternative and to assess the discriminating power of the perceptual scales. For each product alternative perceptual differences between groups of influencers are then tested via multivariate profile analysis [Morrison 1976]. If the groups differ in their perception of an alternative, univariate analyses of variance are used to isolate those items that are the major sources of the differences.

Figure 4 outlines the steps in the evaluation space analysis. Variance-covariance matrices between all perceptual items and across all product alternatives are calculated for each group of influencers. If these matrices are unequal, they are factor-analyzed separately and the parallel analysis method [Humphreys and Ilgen 1969] is used to determine the dimensionality of the evaluation space for each group of influencers.

Groups of influencers with an identical number of evaluation criteria are tested for equality of these criteria using a test presented in Choffray and Lilien [1976]. If the evaluation criteria are similar, the common perceptual space is obtained by factor analyzing the pooled covariance matrix for the corresponding groups. The final step of the analysis is preference estimation, linking individual preferences to product coordinates in the appropriate evaluation space.

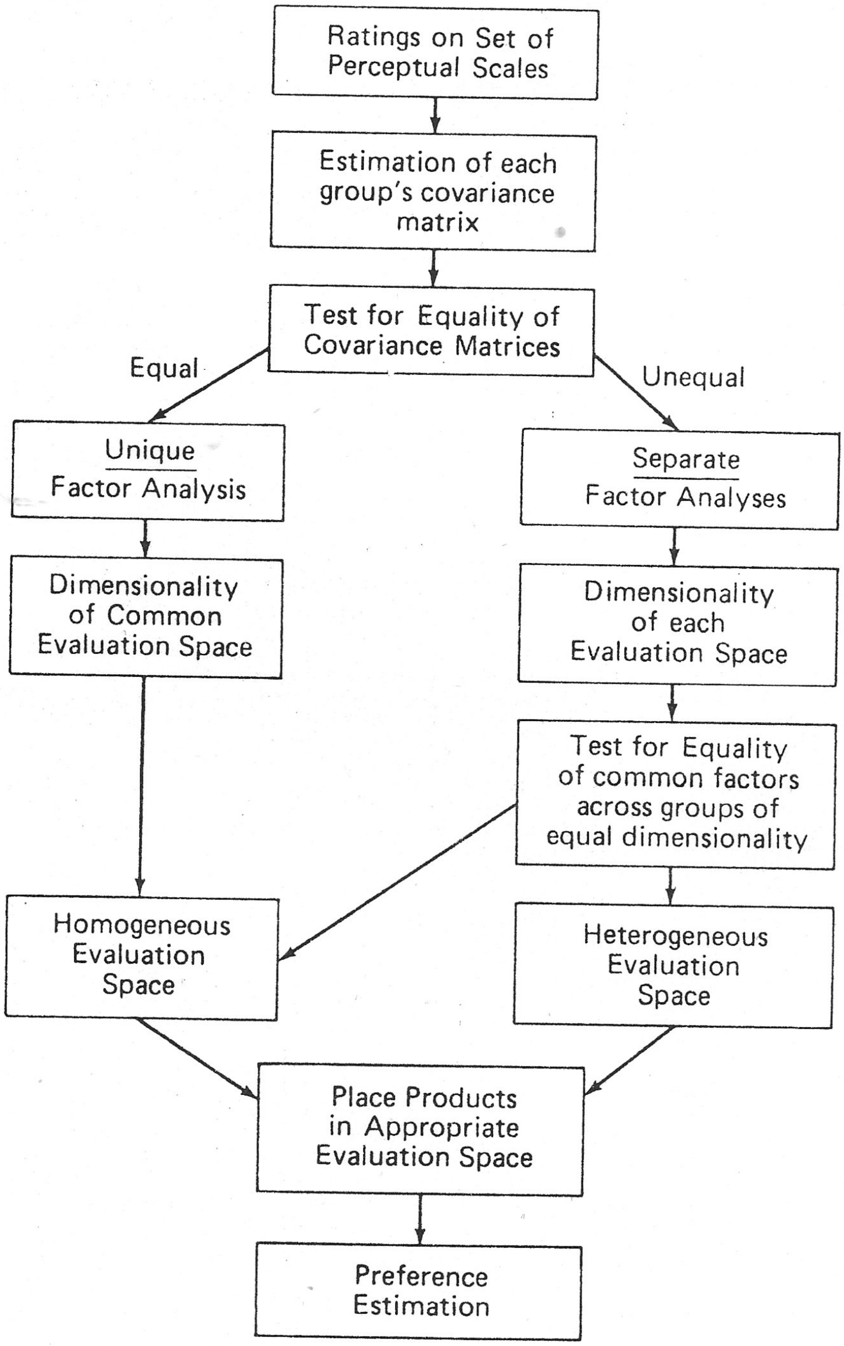
IMPLEMENTATION OF THE METHODOLOGY: INDUSTRIAL SOLAR COOLING CASE

The data used below were collected as part of an Economic Development Administration funded study to explore U.S. market potential and develop strategy for introduction of industrial solar cooling. A sample of firms was selected by size, Standard Industrial Classification code and geographic area. A senior management member was identified and sent a personal letter asking for the names of two or three members of his organization most likely to be involved in the adoption decision process for industrial cooling equipment. A detailed questionnaire was then sent to the individuals mentioned. This two-step sampling procedure increased the likelihood of reaching key people in the adoption decision for this class of product.

The questionnaire requested information about the company, its requirements for products in this class, its decision process and personal information. Each respondent was also

Figure 4

OUTLINE OF EVALUATION SPACE METHODOLOGY



exposed to three product concept statements describing the solar alternative and two conventional cooling systems. Perceptual ratings were obtained for each of these concepts on a Likert scale including fourteen statements about possible product attributes (see Figure 5). Conditional preferences for the alternatives were then obtained, using both rank and constant sum paired comparison methods.

As interviews with company executives indicated that HVAC (Heating, Ventilation and Air Conditioning) consultants have great influence on the decision to adopt the new solar cooling alternative, a similar document was prepared and sent to HVAC consulting firms. In this analysis, purchase influencers were grouped on the basis of job responsibility. As some variation must be expected across companies in the responsibility corresponding to different job titles, a request was made in the questionnaire that the respondent describe his main job responsibility. Five groups of respondents were then created.

Figure 5

STATEMENTS USED FOR INDUSTRIAL COOLING SYSTEM EVALUATION

1. The system provides reliable air conditioning.
2. Adoption of the system protects against power failures.
3. The system is made up of field-proven components.
4. The system conveys the image of a modern, innovative company.
5 The system cost is acceptably low.
6. The system protects against fuel rationing.
7. The system allows us to do our part in reducing pollution.
8. System components produced by several manufacturers can be substituted for one another.
9. The system uses too many concepts that have not been fully tested.
10. The system leads to considerable energy savings.
11. The system is too complex.
12. The system provides low cost a/c.
13. The system offers a state-of-the-art solution to a/c needs.
14. The system increases the noise level in the plant.

We distinguished among production engineers, corporate engineers, plant managers, top managers and HVAC consultants.

Perceptual Analysis Results

Application of the methodology described in Figure 3 led to the conclusion that each group of decision participants perceived the three available alternatives as substantially different [Choffray 1977]. This result was not unexpected as the three products indeed presented important differences. Significant perceptual differences were registered between groups of decision participants for each product concept [Choffray and Lilien 1976].

Analysis of the perceptual differences via one-way, univariate analysis of variance suggests for example that plant managers view solar cooling (SOLABS) as a more substantial means of protection against power failures than do HVAC consultants. They also consider it more cost effective than HVAC consultants. Finally, plant managers view SOLABS as a complex system whose components have not been fully tested but which provides a state-of-the-art solution to industrial cooling needs. HVAC consultants' perceptions of SOLABS differ considerably in this last respect. For further discussion and review of other pairs of groups see Choffray [1977].

In summary, the results of this part of the analysis confirm the existence of substantial perceptual differences among these different groups. The selection of the scales also appears appropriate as they all contribute to the differences noted among groups of decision participants.

Product Evaluation Space Results

Individual covariance matrices were estimated for each of the five groups using ratings obtained on the fourteen perceptual scales. The hypothesis of equal covariance matrices was tested and rejected and a separate principal factor analysis was performed for each group. The dimensionality of each group's evaluation space was obtained by the parallel analysis method. Table 1 summarizes these results and can be interpreted to mean that production engineers, top managers, and HVAC consultants who have relatively more responsibility in the decision

Table 1

EVALUATION SPACE DIMENSIONALITY

Group	Dimensionality of Evaluation Space
Corporate Engineers	2
Plant Managers	2
Production Engineers	3
Top Managers	3
HVAC Consultants	3

process [Cheston and Doucet 1976] appear to use more decision criteria.

The equality of evaluation criteria in the case of common dimensionality of the evaluation spaces for corporate engineers and plant managers and for production engineers, top managers and HVAC consultants was statistically rejected. This suggests substantial differences in the composition of these evaluation criteria across groups of influencers. The interpretation of these evaluation criteria leads to interesting qualitative distinctions between decision participant groups. For the two factor solutions we summarize and interpret the results in Table 2.

The issue of cooling systems' initial costs does not appear as clearly for plant managers as the issues of modernness, energy savings and protection against fuel rationing and power failures. On the other hand corporate engineers see the system's reliability and first costs as primary issues.

Similarly, Table 3 presents an interpretation of the factor solutions for the other three groups: top managers, production engineers and HVAC consultants. The composition of the first factor indicates minor differences between these groups in terms of their first evaluation criterion (top managers include protection against power failures and HVAC consultants do not place the same emphasis on low operating cost). Major differences, however, arise in the second and third factors. Production engineers emphasize system complexity and modularity more than other groups. First cost comes out clearly as an important element in top managers' evaluation of industrial cooling equipment. Our analysis of the evaluation space for

Table 2

COMPARISON OF FACTOR SOLUTIONS FOR CORPORATE ENGINEERS AND PLANT MANAGERS

	Factor A	Factor B
Corporate Engineers	field tested first cost reliability noise level	reduced pollution energy savings/protection modernness
Plant Managers	energy savings/protection low operation cost reduced pollution modernness	reliability/field tested modularity noise level

Table 3

COMPARISON OF FACTOR STRUCTURES FOR PRODUCTION ENGINEERS, TOP MANAGERS AND HVAC CONSULTANTS

	Factor A	Factor B	Factor C
Production Engineers	energy savings/protection low operating cost modernness reduced pollution	modularity noise level	complexity field tested/reliability
Top Managers	energy savings/protection low operating cost modernness protection against power failure reduced pollution	reliability/field tested initial cost complexity	noise level
HVAC Consultants	modernness reduced pollution energy savings/protection	field tested/reliability	noise level initial cost

each group of participants suggests that they differ both in the number of evaluation criteria and in the composition of those criteria.

MARKETING IMPLICATIONS

In order for our results to be useful in industrial marketing strategy formulation, differences in evaluation criteria between decision groups should relate to individual preferences for available alternatives. For this purpose a set of regressions was run, linking product alternatives to stated preferences. Table 4 summarizes the results, assuming different evaluation criteria for each decision group.

Interesting differences in the way product evaluations are related to individual preferences appear within each group. Corporate engineers find reliability and first cost most important while plant managers find modernness, fuel savings and low operating costs to be most significant. The comparison of the other three groups is most interesting. Production engineers find modernness, low operating cost and protection against fuel rationing most important. But they seem to favor less field proven and less easily substitutable equipment. Production engineers are perhaps the only individuals in the decision process who will work with this equipment directly and seem to favor equipment which makes their job more challenging. Top managers also find modernness, protection and low operating cost most important but also consider reliability and initial cost. Finally, HVAC consultants do not seem concerned about modern image, low operating cost and fuel rationing protection. Their concerns are immediate—they consider initial cost and noise level most heavily and then reliability and the presence of field-proven components.

Each of these groups not only evaluates the various alternatives differently, but the nature of the link between product evaluations and individual preferences is different as well. These results suggest that when communicating with top managers and plant managers, low operating and initial costs should be stressed, along with company image modernness and protection against fuel rationing. When promoting the new product to an HVAC consultant first costs, reliability and low noise level should be emphasized. Using this analysis, a sales presentation or advertisement for solar cooling aimed

Table 4

IMPORTANCE OF ISSUES TO DIFFERENT GROUPS OF DECISION PARTICIPANTS

	Issues of *Key* Importance	Issues of *Less* Importance
Production Engineers	modernness protection against fuel rationing modularity/field proven substitutability	first cost
Corporate Engineers	reliability first cost	modernness of image energy savings
Plant Managers	protection against fuel rationing modernness low operating cost	first cost
Top Managers	protection against fuel rationing modernness low operating cost	noise level in plant ease of component replacement
HVAC Consultants	noise level in plant first cost reliability	modernness low operating cost energy saving

at top mangement via a business-oriented publication might stress:

> "Be a leader in your field and insure yourself against the hardships of rationing—use solar cooling," etc.

whereas sales material directed at HVAC professionals would stress

> "Solar cooling—the quiet, reliable cooling system best suited to your clients' needs. Offers substantial long-term savings," etc.

These issues also have important impact on design. For example, reliability is an important issue across groups and might justify R&D expenditures for establishing reliability standards for the equipment. The preference models provide a tool in determining what an improvement in the image of product reliability will do to receptivity for each group. These issues will be explored in detail in a future analysis which develops a marketing program for solar cooling.

ASSESSMENT AND CONCLUSIONS

The major implication of this analysis for the development of industrial product marketing strategies should be assessed at two levels:

A. *Differences in Product Perception*

- Identification of industrial product characteristics which are not perceived by a group of influencers so that corrective action can be taken in a product redesign or repositioning strategy.

- Development of advertising copy which accounts for the specific needs and requirements of each group of decision participants.

B. *Evaluation Criteria Differences*

- Identification of areas of potential weaknesses in design and positioning by assessing the new product's position relative to that of competitors in the appropriate evaluation spaces of different groups of decision participants.

- Development of communication programs and product presentation strategies that account for the needs and evaluation criteria of different groups of buying influencers.

The methodology outlined here is a new approach to analyzing important behavioral components of industrial buying decisions. It is now being used to investigate the adoption of "smart" computer terminals, thermic diode solar panels, and business communications systems. The procedure uses new methods of analysis on data collected by inexpensive, standard survey research techniques. It offers insight into the differences between members of the buying center that have direct implication for product design and marketing strategy formulation. This methodology is part of a research effort aimed at developing better tools for analyzing industrial markets. Here we stressed the analysis of perception, evaluation criteria and preferences for different groups of participants in the industrial adoption process. This field of research needs better models and measurement tools. The results here indicate that potential for improvement exists.

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