PROCESSES AND TOOLS FOR DECISION SUPPORT

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edited by

Henk G. SOL
University of Groningen
The Netherlands

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PRACTICAL EXPERIENCES WITH THE PROCEDURAL DECISION MODELING SYSTEM

R. Maes
University of Amsterdam, The Netherlands

J. Vanthienen
&
M. Verhelst
Catholic University of Leuven, Belgium

The PROcedural DEcision MOdeling (PRODEMO) system was developed to enhance the application of decision tables as a general management technique. This shift of focus with relation to the usefulness of decision tables is briefly indicated in the paper, after which the proper PRODEMO system is presented. Then attention is given to practical experiences with the PRODEMO system in multiple organizations. To this end, three typical case studies are reviewed and empirical results obtained from many other cases are reported on.

1. INTRODUCTION

Originally, decision tables were developed as handy tools for computer programmers, who were confronted with logically complex representation problems. Despite this very practical issue, a great part of the 'classical' literature on decision tables is devoted to the single problem of optimally converting decision tables into programs, whereas their practical applicability is greatly neglected. This distortion was accused for the first time in [1].

Looking for the reasons of this anomaly, we struck upon the following:

1. The applicability of decision tables as a *programming* technique is indeed rather limited, as was investigated in [3].
2. *Constructing* decision tables starting from conventional texts and/or human reasoning processes is the real key problem. Only by the development of adequate methods for constructing decision tables (see [8], chapter 2), the introduction of the computer into this modeling process became possible.

With regard to the first cause, the conviction that decision tables should be used outside the proper programming sphere, is more and more gaining ground. In [7], it was shown that decision tables are useful as a general management technique. Their potential value during the preliminary, users-oriented phases of the information systems life cycle is demonstrated in [3] (chapter 4).

The aim of this paper is threefold:

1. To demonstrate by real-life examples, the usefulness of decision tables as a decision support technique. (Sections 2 and 4).
2. To present the PRODEMO system (Section 3). This system enables the computer supported construction and manipulation of decision tables and in this way really is a significant step towards a non-trivial DSS generator.
3. To report empirical results obtained from a great lot of field research on the applicability of the PRODEMO system (Section 5).

2. DECISION TABLES AND PROCEDURAL DECISION MAKING

2.1. Procedural decision making

A large part of decisions to be made in organizations are of a procedural nature. They require the application of rules, regulations, laws, policies, etc.. Very often, such rules are of the following type: 'If condition 1 and condition 2 and ..... and condition n are met, consequence 1 and ..... and consequence m applies'. Even when decisions are made on an intuitive basis, it can frequently be shown that strict procedures are followed, albeit unconsciously.

If procedural decisions should be made by other persons than the ones who prescribed the underlying procedures, these procedures must be documented. This is usually done by means of narrative. We will call this: *a-priori structured* procedural decision situations.

If decisions are made by the same person who made the rules, then documentation may or may not exist. If it does not exist, the rules (conscious or unconscious) are in the head of the decision-maker. This latter case will be called: *a-priori unstructured* decision situations.

In the 'a-priori structured' case, several problems appear:

(1) it takes time for the decision-maker to study the procedures before being able to make the decision or to draw the conclusion;
(2) very often, the text is unclear and can be misunderstood, leading to wrong decisions or conclusions;
(3) very often, the text is not exhaustive (i.e. does not treat all possible cases) and is hiddenly contradictory in many places, which again entails poor decision making.

Problem (1) is inherent to the fact that natural language is used; problems (2) and (3) can be avoided if the person who made the procedures is an extremely intelligent one (but only few procedures are made by persons of that type). It follows that in actual practice all three problems are frequently experienced, leading to poor decision making. Moreover, they grow very fast as a function of the complexity of the decision situation. They can all be avoided by using decision tables instead of narrative as a means of documenting the decision. Decision tables can also be very useful in the a-priori unstructured case. They can become a vehicle for modeling the decision process such that the process gains in objectivity, logical consistency and efficiency (for an example, see subsection 4.1).

2.2. Decision tables

For clarifying the power of decision tables in the context of procedural decision situations, let us consider the case of a-priori structured decisions, i.e. procedural decisions documented by means of natural language.
Standard methods exist ([8]) for translating narrative to decision tables. They will be presented briefly in subsection 2.4.

We will now illustrate how decision tables can dispel the above-mentioned problems by comparing a typical narrative (figure 1) with the decision table derived from it in such a standard way (figure 2).

ORDER HANDLING

1. Discount

   Only wholesalers are granted discount, provided that they order a quantity of at least 10 units. The discount rates are 10 %, 5 % and 2 %: 10 % for wholesalers ordering at least 15 units, or living at a distance of less than 50 km and ordering at least 10 units; 5 % for wholesalers ordering at least 10 but less than 15 units and living at a distance of at least 50 km but less than 100 km; 2 % for wholesalers ordering at least 10 but less than 15 units and living at a distance of at least 100 km.

2. Way of transportation

   We transport by railway if the order is not from a wholesaler or if a wholesaler orders at least 15 units. In all other cases transportation is by road.

3. Type of invoice

   The normal type is A. Exceptionally, an invoice type B should be made, viz. for a wholesaler who orders at least 15 units.

Figure 1

ORDER HANDLING	R1	R2	R3	R4	R5	R6
C1. Customer = wholesaler	Yes	Yes	Yes	Yes	Yes	No
C2. Quantity ordered (Q)	Q<10	10≤Q<15	10≤Q<15	10≤Q<15	Q≥15	-
C3. Distance between warehouse and place of delivery (D)	-	D<50	50≤D<100	D≥100	-	-
A1. Discount in %	0	10	5	2	10	0
A2. Transportation by railway	-	-	-	-	X	X
A3. Road transportation	X	X	X	X	-	-
A4. Type of invoice	A	A	A	A	B	A

Figure 2

Let us now review the contribution of decision tables for solving the three problems mentioned above.

Problem 1: If decisions are made using the decision table, a maximum of 3 questions must be answered, sometimes only 2 questions (in case R1 or R5 applies) and sometimes only 1 question (in case R6 applies). If all rules occur equally frequently, this makes an average of 2.33 questions. With the text of figure 1, an average of 7.66 questions is needed. Therefore with the decision table, decision speed is increased by a factor of 3.3. The underlying reason is that, by their nature, texts are action-oriented and decision tables are condition-oriented.

Problem 2: Making use of the decision table, fewer mistakes will be made because (1) fewer questions must be answered and therefore the probability of wrong answers is lower and (2) the table does not contains words or

expressions which are easily and unconsciously misunderstood. Examples of such words appearing in the text are: 'only', 'provided that', 'or', 'in all other cases', 'the normal type', 'exceptionally', 'viz', 'but'.

Problem 3: The text of figure 1 is complete and does not contain any contradictions. We will now show how decision tables can be used for finding omissions and contradictions. Suppose that the first paragraph of the text of figure 1 were:

1. Discount

Only wholesalers are granted discount.
The discount rates are 10 %, 5 % and 2 %: 10 % for wholesalers ordering at least 15 units, or living at a distance of less than 50 km and ordering at least 10 units; 5 % for wholesalers ordering at least 10 but less than 15 units and living at a distance of at least 50 km; 2 % for wholesalers ordering at least 10 but less than 15 units and living at a distance of at least 100 km.

Applying a standard method for translating the new text into a decision table with the purpose of finding omissions and contradictions, we get the table of figure 3.
By inspecting the action part of the table, we see that for R1 no discount appears (not even 0 %) which is an omission. Furthermore R4 shows a contradiction: discount = 2 % and discount = 5 %. The advantage of the decision table here is, that such omissions and contradictions are made visible, whereas in the text they remain hidden.

ORDER HANDLING	R1	R2	R3	R4	R5	R6
C1. Customer = wholesaler	Y	Y	Y	Y	Y	N
C2. Quantity ordered (Q)	Q<10	10≤Q<15	10≤Q<15	10≤Q<15	Q≥15	-
C3. Distance between warehouse and place of delivery (D)	-	D<50	50≤D<100	D≥100	-	-
A.1.1. Discount = 0 %	-	-	-	-	-	X
A.1.2. Discount = 2 %	-	-	-	X	-	-
A.1.3. Discount = 5 %	-	-	X	X	-	-
A.1.4. Discount = 10 %	-	X	-	-	X	-
A.2.1. Transportation by railway	-	-	-	-	X	X
A.2.2. Road transportation	X	X	X	X	-	-
A.3.1. Type of invoice=A	X	X	X	X	-	X
A.3.2. Type of invoice=B	-	-	-	-	X	-

Figure 3

2.3. Audience

A very often heard remark concerning procedural decisions is that this category of (repetitive) decisions is located at the lowest level of the organizational hierarchy. One of the basic themes of this paper, however, is that, by properly applying the decision table technique (e.g. by using the PRODEMO system), one

should be able also to "structure" a whole range of decisions traditionally dealt with by tactical management. In this respect, the decision table can be considered as a real structuring tool. Some striking examples will be given in Section 4.

In addition, anyone who is confronted with prescriptions, laws, procedures, ... can (irrespective of any organizational context) benefit from the technique proposed in this paper. The following schematic classification of the audience we were working with in the past may be clarifying in this respect:

- Managers who want to design new procedures or to analyze and correct existing ones used in their organization (or even by themselves).
- Lawyers who are confronted with logically chaotic and even incomplete and/or contradictory laws.
- Legislators who have to design new laws adapted to complex modern life.
- Anyone involved in the design of new regulations and prescriptions in general.
- Systems engineers who have to grasp complex organizational and infological problems.
- Teachers looking for a clear and unambiguous tool for representing complex material.

2.4. The crucial problem: how to construct effective decision tables ?

The crucial problem, commonly neglected in the traditional literature on decision tables, is how to construct tables given a more or less explicit narrative or written decision description. In our opinion this common lack of knowledge is also the main reason why decision tables failed to get accepted as a *practical* technique.

As far as the systematic construction of decision tables is concerned, experience has shown that different methods are needed for the 'a-priori structured' case and for the 'a-priori unstructured' case:

a. The conversion of an a-priori structured decision into decision tables (in order to examine the correctness of the existing representation) involves the application of so-called 'direct' construction methods:
   - if the starting description is rather simple, one can immediately enter the appropriate entries (including don't care's) in the decision table, using any variant of the progressive rule development method (see, e.g. [2]).
   - in any other case, a two steps method can be applied:
     1. the original text is translated into equivalent logical expressions (originally proposed in [6]).
     2. these expressions are used to fill in the action entries of the completely expanded decision table.

b. When dealing with a-priori unstructured situations, decision tables can very well be used as structuring tools. In this case, so-called search methods for constructing decision tables have to be applied (see [8]).

All these methods will be illustrated in Section 3, when dealing with the interactive PRODEMO system for constructing and manipulating decision tables. It will be demonstrated that this system enables us to use the different methods in any arbitrary combination. This feature has proven to be very useful.

3. THE PRODEMO SYSTEM

The PRODEMO (PROcedural DEcision MOdeling) system is a computer program for constructing and subsequently using decision tables. In the following, we successively deal with:

- the reasons for computer introduction into the decision table manipulation process (3.1)
- the philosophy behind the PRODEMO system (3.2)

- the PRODEMO modeling methodology (3.3)
- PRODEMO and decision *making* (3.4)
- PRODEMO and the application of decision table *structures* (3.5)

Finally, in 3.6, some considerations are given on the actual implementation.

3.1. A rationale for computer introduction

In Section 2, straightforward manual procedures for constructing decision tables were mentioned. However, in a high number of cases, the complexity becomes overwhelming; then, introducing the computer into the construction process is the obvious means to enlarge the applicability of the decision table technique. The following reasons can be put forward:

1. Combining different construction methods is hardly possible without the assistance of the computer. Besides, an interactive computer program, like the one presented in this paper, can give valuable indications about the desirable method.
2. The automatic generation of condition entries guarantees the completeness by enumerating all possible combinations of condition ranges.
3. A lot of administrative and clerical work that inherently accompanies the use of the decision table technique can be taken over by the computer.
4. Some manipulations of the resulting decision table can very easily be automated.
   Ex.: - the contraction of the decision table using various criteria;
   - reordering the conditions and actions.
5. Some other manipulations lend themselves very well to the use of interactive problems solving techniques.
   Ex.: splitting up a decision table.
6. The resulting decision tables can, in a further stage, form the basis of computer based decision making (see below).

3.2. The PRODEMO philosophy

As was outlined, the main purpose of the PRODEMO program is to guide and support the user during decision modeling as well as during decision making by giving suggestions and feedback, by checking for incompleteness and inconsistencies and by executing all of the administrative routine tasks and the combersome drawings.

No special knowledge is required in order to use the PRODEMO system. The interactive environment, in which it has been conceived, guarantees an extended and effective user support when this is required and is able to create a highly flexible and well controlled use of the system.

The PRODEMO system is able to operate in one of two modes:

- Command mode : the user takes control of the program and determines his path through the modeling process.
  This is achieved by grouping all important functions on a central index page: the PRODEMO menu (see figure 4 below). From this page the user can choose which option he wants to take, execute it and then return to the menu to choose another option. One of the options is to load previously constructed decision tables in memory and to use these tables.
- Response mode : the computer controls the program and leads the user through the modeling process.
  The construction of the decision table is accomplished through suggestions of the PRODEMO software, after deducing underlying rules and constraints.

3.3. PRODEMO modeling methodology

Since any procedural decision is translated into its equivalent decision table, PRODEMO in order to start the modeling process needs at least:

- a table name
- some prevailing conditions and their states

- some actions
- some relations between conditions and actions (in the form of logical expressions).

The supply of all these elements is grouped around the MENU-page (figure 4). From this page the decision description is gradually built up, while fully exploiting the advantages of the decision table scheme.

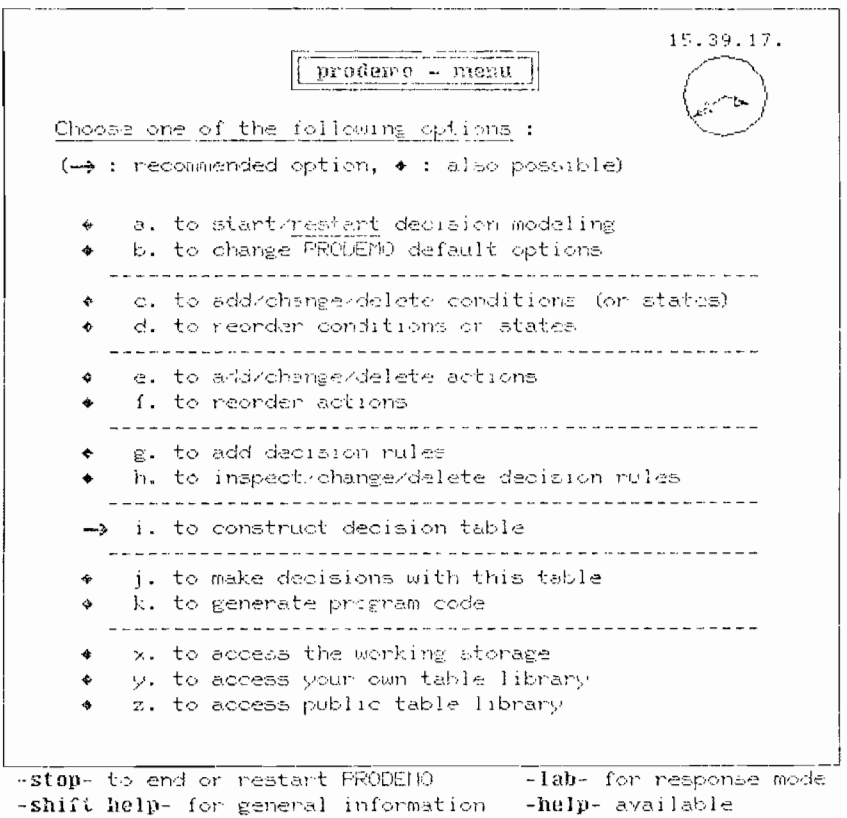


Figure 4

The general methodology to be followed by the PRODEMO user is very straightforward: at any given moment he enters all the information he has about the decision; the most obvious way to do that is by entering all conditions (with their states) and all actions he has in mind (see, e.g. [7]). Then he can enter the decision logic. Using PRODEMO, this can be done from the Decision Input page (see figure 5).

On this page, sequence numbers are used for referring to conditions and actions

and letters are used for referring to condition states. The decision logic is expressed by relating condition states and actions by means of a straightforward syntax. Suppose e.g. that the following sentence is part of the order processing example treated in figure 5: 'An order should be put on a waiting list if stock is not sufficient and if either the credit limit is not exceeded or if the credit limit is exceeded and the customer is important'.
This sentence results in the following logical expression (cfr. fig. 5):

3 ← 2b and (1b or (1a and 3a))

This means that action number 3 ('Put order on waiting list') should be executed each time that condition 2 ('Sufficient stock ?') has its second value ('No') and either condition 1 ('Credit limit exceeded ?') is 'No' (1b) or condition 1 is 'Yes' (1a) and condition 3 is 'Yes' (3a).
Notice also that the number of mutually exclusive states a condition can have is not limited to two. If more than two states exist, they are indicated by a, b, c, d, etc. ...

At any chosen time, the user can ask the PRODEMO system to construct and display the decision table (option i in figure 4).

Constructing a table implies matching the logical expressions to an expanded table, contracting the table, checking for errors and displaying the table on the screen.

When contracting a table, the user can choose between:

- a contraction with the given condition order;
- a contraction with optimal condition order.

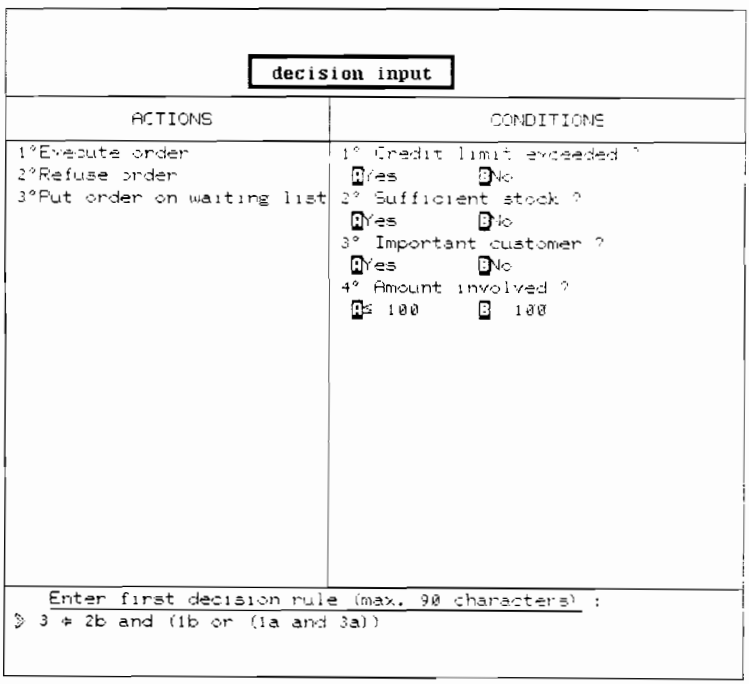


Figure 5

The latter option minimizes the table length (number of columns) by reaching an optimal condition order, which improves both the efficiency of automatic decision making and the clarity and ease of use by a human decision maker. The condition order can also be subjected to precedence constraints.

Suppose now that, at a certain moment, the developing decision table looks as in figure 6. A simple table diagnosis (provided by PRODEMO) reveals that column 3 contains contradictory actions ('Execute order' and 'Refuse order') and that column 5 has no executable action. Now the user can either

- switch to touch submode and adapt the table

  or

- switch to response mode and ask PRODEMO what to do next

(this latter option is more convenient for elaborate tables involving lots of conditions).

ORDER TREATMENT

Credit limit exceeded ?	Yes						No	
Sufficient stock ?	Yes			No			Yes	No
Important customer ?	Yes	No		Yes	No		-	-
Amount involved ?	-	≤ 100	> 100	-	≤ 100	> 100	-	-
Execute order	x	x	x	-	-	-	x	-
Refuse order	-	-	x	-	-	x	-	-
Put order on waiting list	-	-	-	x	-	-	-	x

Figure 6

Suppose the user wants to add that in the case of column 5 the order should be put on a waiting list. He enters the search submode by pressing a function key and adds the new action entry by simply touching the screen. By inspecting the table, he detects that, in the case of the credit limit being exceeded, the order should be refused when the customer is not important and the amount involved exceeds 100 (columns 3 and 6). He can then correct column 3 either by changing the appropriate logical expressions (cf. supra) or he can immediately adjust the decision table via the touch submode. The end result of this very simple modeling exercise is shown in figure 7 (screen output).

The rest of the PRODEMO menu-page (figure 4) is rather self-explanatory. However, the following conventions/and or comments should be kept in mind:

- the user can impose and change the order in which the conditions, condition states and actions should appear in the table (option d and f in figure 4).
- once a table has been constructed, it is possible to make decisions on an interactive basis (option j in figure 4). This option is further treated in section 3.4.
- although the PRODEMO-system was designed as a modeling tool for the interactive construction of decision tables, it can also be used to translate the resulting decision table(s) in executable source code (option k in figure 4). The resulting code is a non-optimized straightforward translation of the decision table.
- in order to save or reload a decision table or a system of decision tables, one can use a working storage, with rather limited protecting mechanisms (option x),

or have access to the general public library (option z). The latter option is more complex and should only be used for (almost) finished decision descriptions. Any user can also create his fully protected private library (option y).

ORDER TREATMENT

Credit limit exceeded ?	Yes					No	
Sufficient stock ?	Yes			No		Yes	No
Important customer ?	Yes	No		Yes	No	-	-
Amount involved ?	-	≤ 100	> 100	-	-	-	-
Execute order	X	X	-	-	-	X	-
Refuse order	-	-	X	-	X	-	-
Put order on waiting list	-	-	-	X	-	-	X

Figure 7

3.4. Making decisions with the use of PRODEMO

Making decisions is nothing but an option to be taken at the PRODEMO menu page (see figure 4). Actually, this can be accomplished in one of the following two ways:

a. one can display the "active" decision table and simply use it as a versatile and very compact directory for procedural decision making
b. one can ask PRODEMO to "interpret" the decision table(s) (option j in figure 4). In this case, PRODEMO goes through the contracted decision table(s), while confronting the decision maker with the successive relevant condition tests. Practical experience has shown that this "interpretive" mode leads to very fast decision making due to the fact that all redundant information is disregarded and all irrelevant condition tests are avoided.

Moreover, the PRODEMO system automatically links interrelated decision tables when making decisions (see below).

3.5. Decision table structures

PRODEMO is able to deal with structures of decision tables.

A table structure is a collection of interrelated decision tables, concerning the same decision situation. The relations are formed by the fact that some tables are a further elaboration of a condition or of an action of another table.

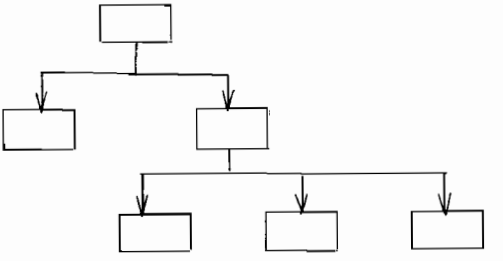
In most cases, all tables within a system can be combined into one single table with the same logic. Such a table, however, would be so large that it would be completely useless. Moreover, the construction of small and related tables, containing coherent decision information, offers some important advantages. It enables the designer to focus on only the relevant aspects of the decision situation part by part and to keep the decision structure in mind. It therefore adds to the modularity and the top-down approach of the problem description.

The relation between tables in a system can take two forms, because of the distinction between action and condition subtables. An action subtable is a table which refines an action of another table. A condition subtable refines a condition of another table, by indicating which condition states are satisfied in the various decision situations.

Only tree structures are allowed. Tree structures consist of one head table with underlying levels of subtables, so that each subtable has one and only one higher

(parent) table. A table can refer to various (lower level) subtables, but it can only be referred itself by one (higher level) table.

The structure of a system might e.g. look like this:



PRODEMO deals with these system relations.
During the decision making process, e.g., the successive condition tests of all relevant tables are automatically presented to the decision maker in their correct order and, depending upon his answers, the actions to be executed are displayed.

3.6. Some notes on the actual implementation

PRODEMO was first implemented on the CDC Plato system. This rather unusual environment was chosen by the fact that

- PRODEMO was created in corporation with the Management and Development Training Department of a Belgian bank. There, the Plato system was extensively used as a training tool.
- Plato had wide facilities for creating visually attractive displays and a touch-sensitive screen which is useful for manipulating decision tables.
- Processing speed and response time had proven very satisfactory even for performing lengthy and complex decision table manipulations.

4. CASE STUDIES

In the following, three real-life case studies are presented, two of which start from written documents (so-called 'a priori structured' situations) whereas the first case study typically deals with an 'a priori unstructured' situation

4.1. Case study 1: Credit granting in a bank

The subject of this analysis was the procedure concerning the approval of cash credit requests. Because of its highly risky nature, this credit judgement has traditionally been dealt with by complex and casual decision procedures. The main concern of the study therefore was

(a) to standardize the procedure as far as possible, and
(b) to create more objective decision criteria, which could also lead to a (partial) computer support.

Unlike the studies of the following paragraphs this analysis is based upon an a priori unstructured problem situation, i.e. the procedure did not confine itself to strict and written operating rules.
Therefore it was necessary to take the following steps, when performing the analysis:

(a) Interviews combined with document analysis, enabled the detection and separation of various judgement criteria. This lead to a mathematical formulation or to a decision table explicitation of each criterion. In the decision tables, the criteria were detailed into measurable or qualitative components (conditions) applying the 'search method' (cfr. [8], § 2.3).
A rough subdivision of these qualitative components into positive (+) average (±) and negative (-) seemed sufficient at first glance.

(b) Due to the absence of written operating rules, the resulting decision tables had to be discussed in detail with the responsable management representative.

(c) Only at this stage the modified decision tables were combined into a hierarchical structure of tables. The cooperation of the related department and the growing insight concerning the structure of the problem have proven very helpful in this respect. (1)

(d) Approval by higher management.

(e) The global and rough value distinctions of the qualitative criteria were translated into operational terms, which together with the measurable criteria added up to a list of 19 distinct elements to be filled in by the bank's credit agent(s) when handling a customer' request.

Though the study was meant to reach an end here, the following, more speculative, extensions have been added:

(f) Based upon the obtained criteria and their relative weightings (implicitly enclosed in the decision tables), tentative 'scores' have been constructed. These can lead, after a precise mutual fine-tuning to the (semi-) automated processing of a number of routine requests.

The contribution of the decision table technique to this study can be summarized as follows:

1. The syntactical scheme of the decision table proved to be an extraordinary tool for detecting all relevant criteria (conditions) of the credit granting procedure.
2. Structuring and relating the various criteria has shown very confusing without the aid of decision tables; these latter were advantageously used for structuring the processes of thought.
3. The resulting decision tables need not be considered as the final step. A more elaborate scoring and weighting could emanate from the obtained decision table structure.

Specific problems in this project concerned the degree of complexity and especially the degree of subjectivity of the problem situation. Constructing an evaluation scale for every criterion, e.g., was a tough and indistinct operation. Other, more general problem areas are indicated in Section 5.

4.2. Case study 2: Technical specifications in a manufacturing firm

A metal construction firm, which produces and assembles various types of pumps, is confronted with a detailed description of specific pump requirements (i.e. the so called API norms).

For every requirement, concerning e.g. material, size, construction, tests, delivery, ..., it is indicated when and for which pump type it applies. In order to satisfy all requirements, the entire standard has to be examined for every pump construction.

Like most procedures and regulations, this kind of standard enumeration is strictly action-oriented, i.e. for every action (requirement) a description is given of when and where it applies. The actual decision process, the detection of the

relevant requirements, is essentially condition-oriented (pump type, operation specifications, ...). 'Translation'of the standards into the condition-oriented decision table format seemed therefore appropriate.

The use of the decision table technique served a double objective:

1. Checking the original text for contradictions and shortcomings, which can be performed very easily due to the specific decision table structure (this is also an automatic function of the PRODEMO system).
2. Simplifying the decision making process, in order to determine the required specifications in a fast and correct way.

In a few days and by extensively using the PRODEMO facilities, the entire document has been rewritten in a number of simple decision tables, an example of which can be found in figure 8.

pressure casing 02/20/81

pumping temperature	<401°F								≥401°F	
thermal shock probable	Y		N						-	
flammable or toxic liquid	-		Y					N	-	
specific gravity at pumping temperature	-		<0.7		≥0.7			-	-	
rated discharge pressure	-		-		≤1000 psig		>1000 psig	-	-	
approval of purchaser for axially split case pumps	Y	N	Y	N	-	Y	N	-	Y	N
radially split case pumps required [2.2.1.]	x	x	x	x	-	x	x	-	x	x
axially split case pumps may be furnished [2.2.1]	x	-	x	-	-	x	-	-	x	-
no special recommendations	-	-	-	-	x	-	-	x	-	-

Figure 8

As most of the standards deal with only a limited number of pump type conditions, there is no need to examine the complete set of requirements everytime a decision has to be made. Pointing out the required specifications can be performed in a straightforward manner, with a minimum of (mis)interpretations and a fair guarantee of correctness and completeness.

4.3. Case study 3: Analysis of a Collective Agreement

The automation of payroll in a large manufacturing firm was troubled by
(a) the complex nature of the collective agreement with the unions
(b) the casual, often unknown, discrepancies between the text of the agreement and the applied operating rules.

Use of the decision table technique succeeded in
- restructuring logically complex articles
- pinpointing some of the ambiguities and discrepancies, one of which was found to have rather important (financial) consequences.

The applied method can be summarized as follows:

(a) In cooperation with personnel management, a number of articles qualifying for further analysis, were selected. Selection criteria were a.o.: logical complexity, experienced interpretation problems and possible advantage of decision table analysis. A short presentation on the use and limitations of decision tables preceeded this selection step.

(b) Analysis of the retained articles with the use of PRODEMO.

(c) Instruction of the responsable personnel management executives.

(d) Confrontation of the results obtained sub (b) and the concrete operation rules. Here again, as in the first case study, a bottom-up approach was preferred, which improved the motivation of the responsible end users.

This comparison often showed substantial deviations, in which case separate decision tables had to be constructed in order to deal with these discrepancies between the text and the real implementation of some calculation procedures.

(e) Final report.

Perhaps more advantageous than the achievement of the specific objectives was the introduction of the decision table as a useful technique to the responsable management.
This project also thoroughly illustrated the power of the technique as a means of communication between different management levels and executives.
These and other common experiences are briefly summarized in Section 5.

5. EMPIRICAL CONCLUSIONS

In our opinion the foregoing examples, taken from a vaster lot of empirical studies, fully illustrate both the applicability of decision tables as a decision support technique and the contribution of PRODEMO as a decision support system.

As is demonstrated by case studies 1 and 3, the computer-supported use of decision tables is rated at its greatest value during the administrative/organizational analysis phase, leading towards a more valuable information system. Notice that this phase not necessarily implies the development of an *automated* information system.

In what follows, we mainly evaluate the use of decision tables and of the PRODEMO system from this perspective. We successively deal with

- some empirical notes on the use of decision tables as a decision support technique (5.1)
- the repercussion of practical experiences on the further development of the PRODEMO system (5.2).

5.1. Decision tables as a decision support technique

As was indicated in Section 2, only a well-defined class of *procedural* decisions can be influenced in a positive way by the systematic application of decision tables. Practical studies, however, revealed that this class covers a wide range of (certainly not always well-structured) decisions at each level of the organizational hierarchy. In what follows, we try to summarize our experiences obtained in application studies in different fields.

5.1.1. The changing role of the decision/information analyst

a. The very simple, computer-independent structure of the decision table enables the users to analyse *themselves* their activities and/or decision processes. By the exhaustive enumeration of the successive cases in the condition part of the decision table and by the numerous PRODEMO features for manipulating the decision description at hand, the users are stimulated to proceed into the direction of a highly *autonomous* design of better procedures.

b. Due to the fact that activity/decision procedures are *documented* in a more understandable way, the decision/information analyst becomes a more replaceable person. Instead of being responsible for the final content of the information system under development, he is assigned the role of catalyst.

5.1.2. The changing users' attitude

a. By many users of the PRODEMO system, the decision table scheme and the facilities offered by the interactive system for dealing with *structures* of decision tables were appreciated as a handy tool for maintaining an overview of their activities. Although no long term experiments are carried through, the use of decision tables seems to become a very natural practice.

b. In some cases, the resulting decision tables were extensively used as means of communication. This feature was especially mentioned by tactical management people, trying to pass down their directives to the operational management level.

c. Initially more amazing were these cases where decision tables were introduced as a tool for detecting divergences between directives (laws, regulations, ...) and their realization in practice. Especially striking were the nature and the dimension of the detected anomalies.

5.1.3. Recommendations

a. Whereas the use of the PRODEMO system itself didn't add any additional problems, the effective and efficient use of decision tables for structuring and/or analyzing procedural decisions was a rather tough problem. Initial *training* by means of case studies incorporating a growing degree of reality is strongly recommended.

b. In order to minimize any *psychological resistance*, the introduction of both the decision table technique and the use of PRODEMO shouldn't start with the computer department. Besides, in a single case better acquaintance with decision tables was used as an interpersonal weapon in the organization under study. Once more, this event underlines the importance of *a priori* training.

c. During this initial training period, the inherent *limitations* of the decision table technique should be discussed. In general, an introduction to decision tables leads to *over-enthousiasm*, which strongly reduces the ultimate effectiveness of both decision tables and the PRODEMO support.

5.2. The PRODEMO system in perspective

Systematic use of the PRODEMO system in its turn influences the further development of the interactive system itself. The following is only a very partial selection out of this mutual influence:

a. *Users' friendliness* of the system is reduced by the increased number of implemented functions. This imminent problem was dealt with by introducing many new on-line help functions. Getting acquainted with the PRODEMO system was made much more simple by the preparation of a programmed-instruction-like text ([5]).

b. Feedback from different PRODEMO-users, together with personal experiences, induced a high number of small changes and improvements, particularly enhancing the ease and speed of use.

c. Unanimously, the availability of PRODEMO is considered to form a fundamental contribution to the practical applicability of decision tables. Functions like

the 'touch mode', changing condition order a.o. are really appreciated in real-life studies, where proceeding in a straight forward and irreversible way is almost utopian.

The extension of the available PRODEMO capabilities should be looked for in two directions:

a. A more powerful and above all more differentiated interactive specification language should replace the current one. A first proposal was elaborated in [3].

b. By incorporating higher intelligence in PRODEMO, one could enter functions like the automatic detection of 'trends' during the decision specification phase and the automatic splitting of too complex decision tables into a hierarchy of smaller subtables.

Final Note

Parts of this paper, especially sections 2 and 3, previously appeared in a slightly different form in [4].

(1) This so called 'bottom up' approach also enlarges the user's trust in the capabilities of the decision table technique.

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