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A study of end-users' behaviour by means of an automated assessment method

(or a behaviour typology of end-users)

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Abstract:

This research, beyond a typology taking into account (1) the abilities or knowledge level of the different users (expert end-users, non-expert end-users, and data processing expert users), which has already been studied abundantly, and (2) the functional dimension (internal staff, retailer, and customer), characterizing the commercial environnment in question, attempts to show the interest of a typology based on their behaviour. We then identify five user types: curious, undecisive, hesitant, resolute and nosy. To do this, we use an automated assessment method (tracing), integrated into a decision support telematic tool, intended for any and all end-users by means of Minitel (in a marketing information system). Moreover, this method enables us to define a structure "H" for developing data communication tools. The main contributions of this research apply to (1) design and implement a method integrated to a telematic server for observing its users, as well as (2) define a behavioural dimension for a end-users analysis. In fact, all this constitutes a reference framework which is especially useful to people working with systems assessment, and having available such a behavioural typology (obtained by analysing the automated tracing) enables them to better understand the reactions of the various end-users.

Keywords: DSS - real time - information - telematics - Minitel - end-user - interface data-oriented system - assessment - tracing - marketing information system

1. Introduction

"Real time management", which was the subject of a special issue of Revue Française de Gestion (1991) and of a recent Simon's conference (1992), is an essential concept in the organization of an industrial enterprise of the future. The purpose of this study is to explore the behaviour of end-users when they are trying to solve a before-sales or after-sales problem, with the help of a telematic server which we have developed and implemented in a computing equipment distribution company.

The efficient use of telematic tools requires that features taking into account the different user types are built-in right at the design stage: to do this, one needs to identify the users and to try to better understand their behaviour modes. The study of users' behaviour is of great interest not only to designers and information systems managers, but also to commercial department heads, who have thus at their disposal a "recording barometer" of the centres of interest of their customers.

The contributions of this article are related to the following issues: (1) conception and implementation of a method integrated to the telematic server for observing users, and (2) definition of a behaviour typology of users. We use the theoretical contributions of decision support and data communications techniques in order to compensate for inadequacies in the information processing mental system of decision-makers and to increase their cognitive abilities. Our research, beyond a typology taking into account the abilities or knowledge level of the different users (which has already been studied abundantly), attempts to show the interest of a typology based on their behaviour.

The motivation for this research work was a need - expressed by the management of the company in question - to improve internal and external communication and to reduce the multiplicity of information sources. This need was related to the telephone network saturation as well as to the time management of specialized commercial and technical staff, either for before-sales service (search for information about a product, which particularly requires input from the Sales Management), or for after-sales service (diagnosis or advice, requiring input from the Technical Management).

There was also an external marketing requirement: to improve the company's public image, to facilitate the dialogue with retailers and customers, and to be able to assess the satisfaction level of end-users. The end result of the program was to design, develop and implement a tool which would enable following: (1) provide information to both the buyer and the Sales Management, as an aid in the choice of products, (2) provide information to both users and the Technical Management in order to assist in installing, setting up and using each of the products.

The purpose of our tool is to make it easier to find and consult information - off-site and in real time - for all end-users. In Section 2, we define what we mean by decision support and how the telematic medium can help. After determining an initial typology of users (Section 3), we describe the *automated* assessment method (Section 4) and present the tool intended for use in the study (Section 5). We then present our findings (Section 6) and draw our conclusions (Section 7).

2. Decision support and its telematic medium

We will now specifiy the conceptual framework in which we find ourselves for decision support, and then we shall demonstrate the significance of the telematic medium chosen. Our interest in this study is the decision made at an individual level (Bonczeck, Holsapple and Whinston 1981, p. 5). According to Newell and Simon (1972), one is faced with a problem whenever one desires something and does not know - initially - the action that would lead to a solution. From this

point of view, they note the significance of the initial delimitation of the problem, which will help to identify the relevant information, which one can find either in one's knowledge, or, failing that, in other sources. This shows the important part played by the tool offered.

Among the different studies of decision mechanisms, we have chosen the conventional model "intelligence-design-choice", of Simon (1957), who sees three distinct and sequential stages in the decision process: (1) **intelligence** of the situation, (2) in order to **modelize** various possible solutions, and finally (3) **choose** the most appropriate solution and apply it. In order to emphasize the iterative aspect of this process, Simon (1977) introduced a fourth assessment stage ("review").

In the stage of **intelligence**, the main elements of the problem are highlighted. The variables relating to the current situation are identified and the information, which will be used for the assessment, is collected. The following stages are intended to create possible scenarios and to choose one of them. The model developed by Simon is used by Gorry (1971), for the specific problems of decision makers (INFORMATION, DECISON MAKER and DECISION). The information stage (of the individual decision process) is the most time-consuming for managers (Simon 1957), any attempt at improvement is then justified: we intend to intervene in the information stage.

Research on problem solving carried out by Newell and Simon (1972) have shown that - due to limitations of a cognitive nature - people who take a decision are restricted in their abilitiy to solve problems. This is confirmed by the work of Miller (1956) on limited cognitive ability: the famous "number 7 plus or minus 2" law. According to Simon (1957, p. 137), the choice is always made in a simplified, limited and rough pattern of the actual situation: this is the principle of **limited rationality**. One should also take into account two other aspects that can influence the information processing mental mechanism. On one hand, the **cognitive style** corresponds to the way in which the person apprehends and interprets the information: Mason and Mitroff (1973) have demonstrated the significance of the way in which the information is set out and the cognitive features of the person whom it is intended for. In addition, Festinger (1957) notes that an individual in a choice situation is in a state of psychological tension. To reduce this tension, he has to develop an unconscious mechanism in order to favour the information which is in line with his choice, to the detriment of conflicting information: this is what he calls the **cognitive dissonance**.

In order to compensate for these limitations, and help individuals (decision-makers) in the initial stage of the decision process, we bring them additional memory capacity, which is represented by: (1) stored information of the different products and their features, use, setting up and configuration, (2) different selection procedures (multicriterion, tree structure and natural language), and (3) a varied presentation of information (text, images, ...).

In order to implement all these features in one tool, where users can be in any location, even far from their firms, the medium used must be a telematic tool, which combines the fields of both data processing and telecommunication for processing the information. Because it is well known and has become an element of everyday life in France, our natural choice was Minitel (Sentilhes, Prevost and Merle 1990). It provides to any end-user, real time access to an information server, which facilitates circulation, consultation and updating of information. The Transpac network, the videotext (Minitel), as well as data and screen management resources offered by MoViE (Moniteur Vidéotex Etendu, software multi-task development tool; Freitas and Ballaz 1991) have made this achievement technically possible. The features of Minitel (Mirabail 1981), its transparency (ease of use and accessibility for all) and its speed (abolition of distances and real time consultation), make it an appropriate medium. The individual decision-maker will always need an efficient and

available tool to search for information and Minitel indisputably appears as an appropriate means for such a project.

3. In search of a user typology

We first wish to identify a user typology and then define the assessment method for using the tool. The specificity of the subject treated (since possible end-users seem to be fairly different with regard to their occupations or education levels, and as regards to Minitel) has directed the development of a differential approach for analysing information. Since most applications are developed for the typical user, they have to take account of the specific features and reactions of the different types of users. We must therefore consider the *dimension* of **individual differences**, explained by Newell and Simon (1972, p. 3), who declare that an individual may be perceived as a member of different populations".

One has to take account of a functional dimension characterizing the commercial environnment of the firm in question, which is composed of the retailers network and their respective customers. This tool also has an added value for the internal staff of the firm: people in the technical and commercial departments who are responsible for managing the data related to the products catalogue and corresponding data sheets. This is self-evident for people in charge of managing the tool. This functional dimension enables us to define 5 categories of users: (1) customers, (2) subscribers (privileged public), (3) retailers (network), (4) internal staff, and (5) tool manager.

There is also a dimension related to the users' competence in data processing, for which several authors have proposed typologies. We have chosen two categories: data processing specialist (with a good mastery of data processing) and data processing non-expert (with no knowledge at all). Literature offers wider typologies, for instance the typology proposed by Rockart and Flannery (1981) and used by Nelson (1989, p. 252), by Davis et al. (1986, p. 169) and by Panko (1988, p. 29), where six categories are defined. We shall use this classification as a reference, and adapt it to take account of the specific field of our problematics. We can define a data processing competence dimension with three main categories of end-users: (1) non-expert end-users (have no mastery of data processing, and use menus to achieve what they require); (2) expert end-users (master high level commands, allowing them to generate simple reports); (3) data processing expert users (master data processing; they are support staff, programmers and computer specialists at large).

The nature of application and type of medium used (Minitel) do not account for a more *detailed* segmentation: these three categories provide us with enough elements to characterize the users' behaviour. The method defined in the next section allows us to observe the users' behaviour, taking into account the different user types already mentioned, i.e. the functional dimension and the data processing competence dimension.

4. An automated assesment method

The implementation of various tool assessment means allows a more comprehensive analysis of its impact: the assessment global pattern chosen - Figure 1 - consists of different activities, with different instruments, with the necessary precautions being taken. This method (Freitas 1992) is inspired by the work of Jenkins (1983) and Davis, Bagozzi and Warshaw (1989); and it considers the research modes involved, according to the observations of Keen and Stabell (in Alter 1980, p. IX) and of Ives, Hamilton and Davis (1980).

This assessment process begins with checking some prerequisites, making sure a priori that our analyses will not be affected by the aspects to be controlled, that is: (1) identification of an *initial need*, by proving that the would-be public desired to have such a tool and (2) *implementation* strategy, without which one could neglect the tool or even ignore its availability. The control of these prerequisites allows to attribute - a posteriori - the results to the specific features of the tool.

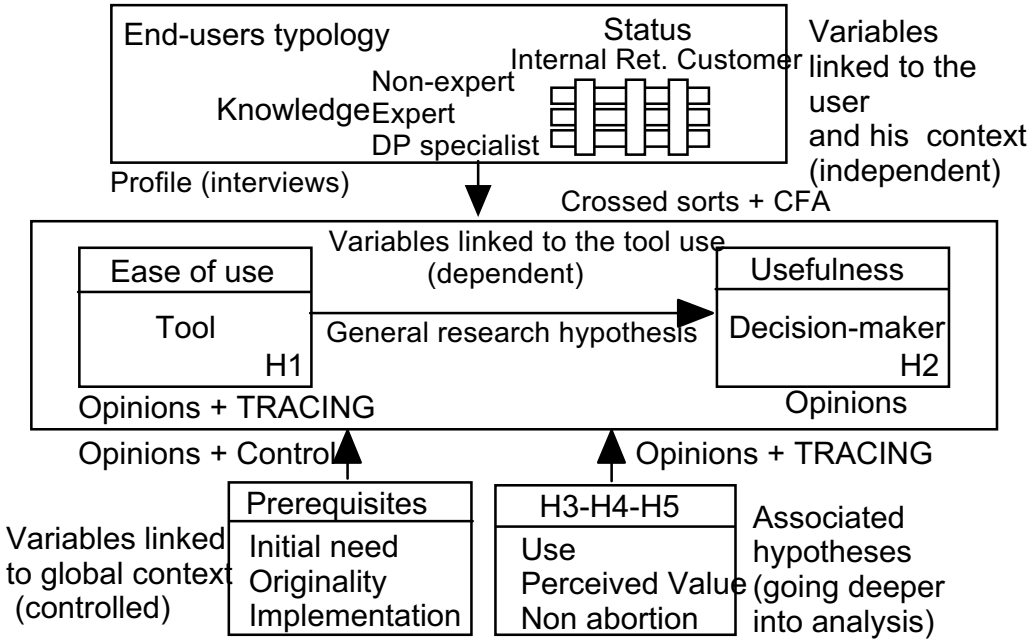

Figure 1 - Global research model

We are convinced that the validation of the tool must be based on two principles: ease of use and usefulness. The following stage is the empiric validation by end-users: data is collected by tracing each Minitel connection, and through direct interviews of users from various categories, with a grid derived from Moles (1990). Five major aspects - related to research hypotheses H1 to H5 - are studied: (1) ease of use of the tool, in checking the functional and ergonomic aspects; (2) usefulness for decision makers, in looking for the impact linked to their activities; (3) effect induced from the frequent use of the tool (Newell and Simon 1972; Courbon 1982), (4) *perceived value* of the tool (Moles 1990), and (5) control of the *non abortion effect* or the *success effect* in the consultation, by observing the impact of each tool menu (situation) on each action (Piaget 1976).

This global assessment model shows the advantage of analysing the tracing (we can store non biased information on the system use): however, the purpose of this article is to focus on studying the user's behaviour. The findings about the global research model are set out by Freitas and Ballaz (1992). Tracing is implemented through a hidden routine. For each connection performed, it records a comprehensive collection of data in following order: initial checking of the user's authorization level (HAB), first option of the main menu (STRAT: 1-product research or 2-technical advice), information research criterion chosen (CHOICE: 1-catalogue, 2-keyword and 3-initiated).

We then store the variables LIST and SHEET to confirm, respectively, the effective opening of a product sheet list, and then of a product sheet. We keep data about the time (ATF) needed to find information (from choice to display of a specific sheet). If the selection criterion chosen is a keyword (WORD), we have created a special routine for counting the number of times the word has been typed, and the number of times the research has turned out to be a success or a failure. Then, we record the variable IMAGE if the user has zoomed on an illustration, and the variable LINK to

check if one or more linked files have been consulted. We have placed counters to check the number of times a user has gone initially to a technical data sheet (TEI) or product sheet (PRI), and to know the number of times he has actually consulted a technical data sheet (TEF) or a product sheet (PRF). The data analysis also enables us to check if the users have made round trips (RT) during a consultation. Finally, we obtain cumulative figures: the number of connections in one day; the number of sheets in a list in one day; the number of sheets consulted in one day; and the time of each connection on the server in one day.

Combining all this information in "macro-variables", with multiple answers (product of this combination), allows to create a "behaviour table" and to define a users' typology: information collected by tracing will be analysed through elementary statistical methods. It should be remembered that tracing is also useful for the company commercial analyses. For instance, there is an obvious commercial interest to know that a product appearing on a list consulted 138 times has had its product sheet displayed only 3 times. Before setting out the findings drawn from the analysis of tracing, we describe the main features of the tool in the following section.

5. A remote decision support system

5.1 - The purposes of the tool

The tool - a telematic server (Freitas and Ballaz 1991) - was developed in two stages: (1) conception and development of the before-sales support system, to help buyers to select (**choice**) the available data processing products (about 400); (2) conception and development of the after-sales system, to help end-users (**support** to customer) to diagnose and solve their problems with setting up, configuration and use of the products they have bought; a technical and commercial message service has been installed. That is an element of a marketing information system (Kotler and Dubois 1989, p. 110).

In addition to allowing us to draw lessons from such an experiment, the **objectives** of setting up the application are following: (1) free the technical and commercial support staff from the task of providing customers with basic information; (2) serve as a shop window (to demonstrate the advice capability); (3) exploit commercially the tracing (data may be demand indicators, collected through the tool itself) and (4) provide customers with quick information, especially as regards phone calls (the internal staff have an "on-line" Minitel on each desk). In the long run, sales representatives might be equipped with portable Minitels. The major goals to be reached are the following: (1) improve communication with would-be customers and with the retailers network, while making the consultation of information on each product easier and (2) provide a more flexible and dynamic technical support.

5.2 - The basic features of the tool

Because there are multiple sources of information, it has appeared necessary to gather all information on both **products** and **technical support** in one single data base. This data is consulted by customers and retailers in specific information display grids, which can only be modified by the internal staff: this allows transparency in the tool operation, on the end-user's side (Treacy 1985, p. 17). It is then a data-oriented application, according to the remote decision support typology proposed by Alter (1980, p. 75). The possibility of consulting illustrations or other data sheets (commercial or technical) linked to the desired information (Jarvenpaa 1989) contributes to the enrichment of the available information, and this feature enables removing the obstacles linked to the cognitive limitations mentioned in Section 2.

We wish to stress the significance of the aspects related to the system-user interface. Bonczeck, Holsapple and Whinston (1981) and Bennett (1983) notes that the quality of the user interface is the most significant explanatory factor when using an application emphasize the significance of man-machine interface for the success of an application. A guide to developing the interface is provided by Sprague and Carlson (1982). Bennett also notes that designer-developers should do their utmost to erase the limits related to the machine or software. We should then develop an interface which is as close as possible to the users' mental representation. Coutaz (1988) advocates a few useful rules: same goal, same command sequence; same arguments, same specification order; same semantics, same denomination; same use, same localization.

5.3 - The tool's functionality

The information sheet is the access target to the application. Users can then navigate in a *flexible* way (zooming on information, links and images) and *transparent* (without being aware of the underlying complex data and image structure). To gain access to the application, the user dials 3616 (telephone) and types the server's code (MINITEL). A greeting image is displayed and the identification procedure is activated (name and password or ENTER). Entry is compared with the CUSTOMER file. The user's NAME is required as a reference in the message service. However, even if the user does not enter his NAME (if he types ENTER), access can still be gained.

Even if the user has not identified himself properly, the application - after a 3rd attempt - allows access, but only to minimum information (so called general public rights). The user will not have access, for instance, to wholesale price or information on assessment versions. After the server has displayed an explanatory screen, the main menu appears: only options 1 (Product Research) and 2 (Technical Data Sheets) can be achieved according to the principles described here. All other options work in *image sequence* mode: they are communication options, which activate the message service for registering in a formation session, taking out a subscription to a magazine, etc.

If option 1 or 2 is selected, a 2nd menu appears: in order to make it easier to find products or technical data sheets, we have designed - at this level - three searching possibilities. To do this, according to the authorization level (customer, retailer, internal) and the selected option (1 to 3), a specific and different information grid is displayed. There are three possibilities: (1) **catalogue**: definition by main key-titles, such as product categories in a catalogue, with a maximum of three selection levels (as in a tree structure research); (2) **keyword**: one or several words dividing the data base, depending on the definition (as in a natural language research); (3) **initiated**: option normally used by other servers, in using one or more fields of the sheet (as in a multicriterion research).

After the user has selected one of the 3 access possibilities, a product list (or technical data sheet list) - according to user's request - is displayed: the user has just to type a sheet number (in the selected list) to obtain the product or technical information (he may also redefine the search criterion to go to another list). Figure 2 illustrates a product sheet.

```
                    PRODUCT:
      1-Reference
      2-Name, Version, Supplier, etc
      3-Retail Price    (VAT.excl.)
      4-Wholesale Price (VAT.excl.)
      5-Description
      6-Illustration
      A >> Linked Products
      B >> Technical Data Sheets
```

Figure 2 - The product sheet

The wholesale price (4) is not displayed for customers or subscribers. Option A or B allows access to linked files. In accordance with the criteria recommended for the interface, the description (5) has always a standard format. On arriving at this screen, the various resources available to the user are: (a) available information, with the option to zoom in on each one (b) graphic illustration, which allows viewing the product or its functionality or configuration; (c) products linked to the product (or to the technical data sheet), which enables the user to know the list of attached products or technical data sheets, and to consult information on each of them; (d) technical details about installation, configuration and use of the product.

To remain in conformity with the theoretical basic principles expressed previously, the user can, at any level, type "*ENTER" to call the message service, "GUIDE" to obtain information on his choice or current position, and "*SUMMARY" to return directly to the main menu. We shall call "H" Architecture the organization of all functionalities of this application, as illustrated in Figure 3.

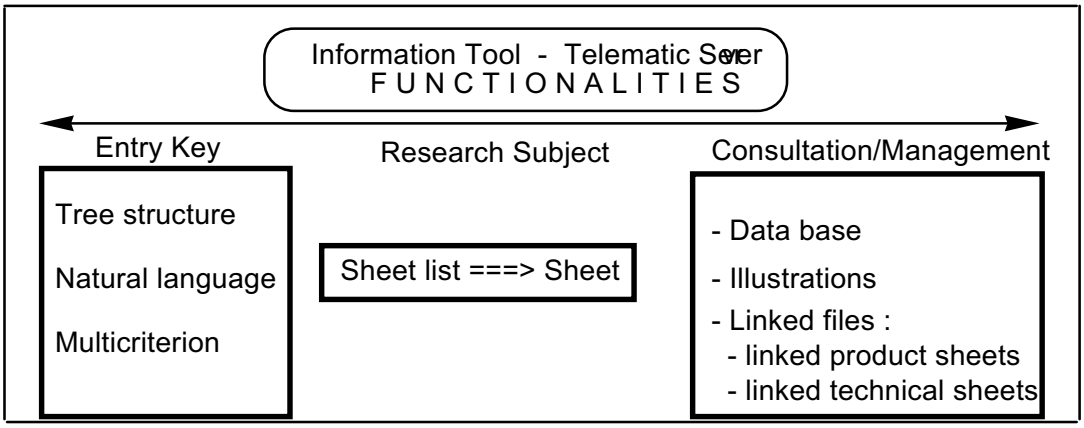

Figure 3 - The proposed "H" architecture

6. The main findings

The analysis of the data collected through tracing (4 months after the tool's implementation) will enable us to present the findings that can be drawn from this study. Applying the proposed assessment method has allowed us to work out a reference framework, which will be of use to all people working in direct marketing or professional telematics fields, as well as to those concerned about providing decision support tools to any end-user. This helps towards demonstrating the applicability of the assessment method proposed. We have recorded the tracing of 53% (32/60) of internal staff (49 recorded connections), 31% (95/300) of retailers and 213 customers.

6.1 - Behaviour of users

We describe below the end-user's behaviour as it is really: that is the analysis of the collected **tracing**, performed first by checking the frequency distribution for each situation (or stage) observed and then by trying to assemble this information into a behaviour table, in order to better understand the actions of the different users within each category. We have recorded nearly 32 hours connection. Table 1 shows the frequency distributions by user category to be analysed.

User:	Internal	Retailer	Customer	Global
Population:	13% (49)	27% (95)	60% (213)	100% (357)

Variable:				
		Consultation strategy (to buy or to use)		
Before-sales (strat)	67%	90%	65%	**72**%
After-sales (strat)	33%	10%	35%	28%
		Criterion for information search		
Catalogue (choice)	39%	38%	58%	**50**%
Keyword (choice)	51%	45%	24%	**34**%
Initiated (choice)	10%	17%	18%	16%
		Success rate in consultation		
List	93%	89%	87%	**88**%
Sheet/total	81%	82%	71%	75%
Sheet/list	86%	91%	81%	**85**%
		Consultation resources		
Links/total	43%	48%	57%	53%
Links/sheet	52%	59%	80%	**70**%
Image/total	45%	51%	33%	39%
Image/sheet	55%	63%	46%	**52**%
Round-trip	33%	17%	26%	24%

Table 1 - Tracing by user category (frequency distribution)

The analysis in Table 1 enables us to state that 72% of consultations are made in the before-sales field, which means that users have connected themselves essentially to find a product, only 28% being looking for a technical data sheet (after-sales). It should also be noted that 90% of retailers have carried out only so called before-sales researches. This is illustrated by Figure 4.

Figure 4 - Crossing : strategy x user

As regards the possibilities of selecting information (Figure 5) 50% of users prefer to use the headlines of the "catalogue", while 34% enter "keywords" and only 16% use the multicriterion option ("initiated"). Customers obviously prefer the "catalogue" (58%), while retailers and internal staff use the "catalogue" (respectively 38 and 39%) and "keyword" (45 and 51%) options more often.

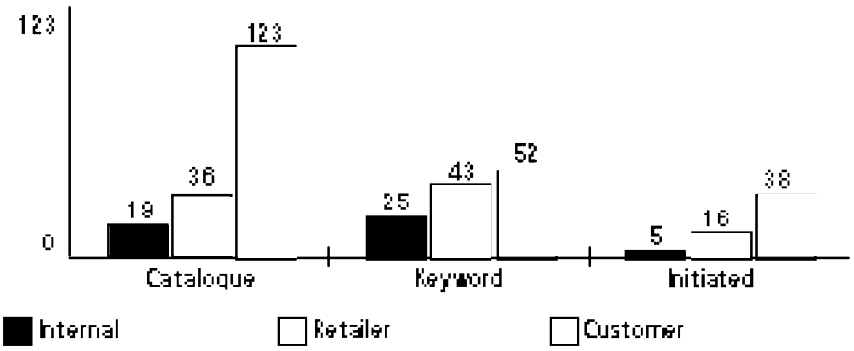

Figure 5 - Crossing : choice x user

It is surprising that only 10% of internal staff and 17% of retailers have used the "initiated" option, since it was intended especially for them: this option implies a minimum knowledge of the different research fields of information on a data base, such as supplier, price, etc. They have shown a clear preference for the other two options.

Within each category, users are globally successful in their consultations, since 88% (316) of those who start a connection (357) get to a solution list, and among them 85% (269) select an information sheet. Among the users having consulted an information sheet (Table 1), 70% have consulted linked information (customers - 80% - much more than retailers or internal staff) and 52% have displayed an illustration.

Finally, it appears that only 24% of all users have made round trips during the consultations.. This may be interpreted in two ways: (1) it is interesting to note that users have found directly (75% of connections have led to a sheet) the information required; and (2) only 24% of users have made round trips, which would suggest that users either have chosen the information very quickly, without looking further for available information, or have decided to quit the tool without any additional research effort. Anyway, the global results that we have just commented show the relative success of the tool among the different user categories.

In order to fully understand the users' reaction, we shall try - below - to identify typical behaviour from the analysis of the collected tracing. Firstly, we have found it interesting to analyse a few crossings (of the contingency tables) as regards tracing variables. We notice (Table 1) that 85% users consult an information sheet from the 316 users who have reached a (alternative) solution list: this means that only 15% of those who have reached a list have not selected or found a sheet. As regards getting to a list, the failure rate is lower: 3 internal people out of 49 (6%), 10 retailers out of 95 (10%) and 28 customers out of 213 (13%). This means that 41 connections out of 357 (only 11%) have failed in consulting a list.

The detailed analysis enables us to check following: (1) in before-sales, 197 connections out of 249 have succeeded (79%), this success rate reaches 88% for internal staff, 85% for retailers and 73% for customers; (2) in after-sales, 72 connections out of 96 have succeeded (75%): that is 69% for internal staff, 89% for retailers and 75% for customers. It should be stressed that only 12 connections have completely failed, since we can confirm that 345 connections out of 357 have succeeded .

Let us now estimate the access time to information according to information selection (choice) criteria, as well as the total time of each connection according to user category.

As regards the analysis of **access time** to information, i.e. the time necessary to choose and define an information selection criterion and to open a sheet from a list of available solutions, it essentially appears that the minimum access time is 31 seconds, the average time being about 52 seconds. For all categories, 78% of the connections have an access time ranging between 31 and 60 seconds, while 22% need more time.

It is interesting to analyse the access time in relation to the information selection criterion chosen: one notices that the users who select the "initiated" option need more than 60 seconds to define a selection. On the other hand, the "catalogue" and "keyword" options have been used in a satisfactory way (between 30 and 60 seconds) by all user categories. Users have then a global preference for the options which enable them to use the tool without having any special knowledge. Since the multicriterion research implies a more precise knowledge of information (the way data is entered has an influence on the results), users prefer to use the "catalogue" option (where they can

choose among available titles) or "keyword" (where they can enter words crossing their minds and nearly always achieve a successful result).

As regards the **connection time** of some user or other, Table 2 gives us fundamental information. We can see that 65% of the users are connected between 4 and 6 minutes and that 29% stay longer, up to 10 minutes. However, it is interesting to know how the connection time is linked to the research strategy (before or after-sales), to the information selection option (catalogue, keyword or initiated), and to round-trip movements.

User:	Internal	Retailer	Customer	Global
Time:				
0 to 4 minutes	4%	5%	7%	6%
4 to 6 minutes	**47**%	**66**%	**69**%	**65**%
+ 6 minutes	**49**%	29%	24%	29%
	average time = 5 min 14 sec		minimum time = 2 min 02 sec	
	standard deviation = 1 min 42 sec		maximum time = 10 min 31 sec	

Table 2 - Connection time to the Minitel server

We notice that a user who connects for an after-sales problem needs more time to consult information: 54% of the connections over 6 minutes are related to after-sales. Out of a total of 50 connections over six minutes, 32 are related to customers. For internal staff (3/25) and retailers (1/71), we can state that there are virtually no after-sales connections under 6 minutes (4/96). On the whole, we verify that 76% of the connections up to 4 minutes are related with before-sales information, as well as 85% of the connections between 4 and 6 minutes. Globally, one can see that 1 user out of 5 consults the tool for less than 4 minutes, 1 user out of 2 for 4 to 6 minutes and 1 user out of 3 for more than 6 minutes. This results show an important time saving with regard to the former methods used to obtain information (printed catalogue and telephone) before the tool implementation.

The analysis of tracing enabled us to describe the actions of the various users concerned and to analyse the influence of this actions on the access time to information and on the total time of each connection. Our global conclusions are the following: (1) there are more connections in before-sales than in after-sales; (2) connections in after-sales are longer; (3) round-trips act on the consultation time; (4) users who arrive to a sheet list go further to an information sheet; (5) the access modes "catalogue" and "keyword" are preferred to "initiated"; (6) the "initiated" access mode generally determines a longer access time to information; and (7) consultation resources (illustrations and linked information) are well used.

Beyond to confirming the validity of the tool functionality and performance, these statements perhaps point out some problem or weakness in the "initiated" research mode, although it is common in this type of information server. This essentially enables us to have a *portrait* of end-users actions in a consultation. We are now studying the end-users behaviours, that is the way they use the tool.

6.2 - The behaviour typology derived from tracing

When analysing data obtained through tracing, we have noticed that, by creating a (ordered) file derived from the original file, we can identify some interesting features with regard to the behaviours of various end-users.

The method consists of aggregating a few variables into a "macro-variable" and affecting to it a qualifying adjective which characterizes its behaviour mode. Eight variables from the original tracing (defined in the Section 4) make up this "macro-variable":

1/2- TEI, PRI : start of the information sheet selection process,

3- Choice : criterion used to select information,

4- List : opening a solution list - products or technical data sheets,

5/6/7- Sheet, PRF, TEF : opening a sheet,

8- RT : round-trip movements.

We have determined seven possible answers for defining a third dimension of the user typology, which we shall call behavioural dimension. These various types are represented in the **behaviour table** (Table 3):

Qualifying adjective	Start	Choice	List	Sheet	RT	Activity
A- **curious** (menu)	0	0	0	0	0	looks at menu and exits
B- **indecisive** (before choice)	1	0	0	0	0	chooses PR or TD but does not choose 1 selection mode
C- **undecided** (selection)	1	1-2-3	0	0	0	chooses 1, 2 or 3 but does not define it completely
D- **hesitant** (list)	1	1-2-3	1	0	0	consults a list and exits
E- **prospector** (list + RT)	1	1-2-3	1	0	1	consults multiple lists and exits
F- **resolute** (straight to sheet)	1	1-2-3	1	1	0	consults a sheet and exits
G- **nosy** (sheet + RT)	1	1-2-3	1	1	1	consults multiple sheets

Key : RT = round trip PR = product research TD = technical data research 1-2-3 = information selection criterion

Table 3 - The end-user's behaviour table

It should be stressed that TEI and PRI are transformed into "**start**" (since we already know whether it is product or technical data); and that TEF and PRF disappear since "**sheet**" already informs us whether a sheet has actually been consulted. "Choice" is of little importance, what we want to know is whether the user has gone further: we know his choice (information selection criterion = 1, 2 or 3) from flat sorting. After having handled the files concerned and carried out statistical tests, we can describe and analyse the results obtained (Table 4): it is a crossed table of "user" (internal, retailer, customer) with the newly created variable (behaviour).

Qualifying adjective	Internal (49)	Retailer (95)	Customer (213)	Global (357)
A- **curious** (menu)	-	4%	4%	4%
B- **indecisive** (before choice)	4%	7%	9%	8%
C- **undecided** (selection)	-	-	-	-
D- **hesitant** (list)	12%	7%	16%	13%
E- **prospector** (list + RT)	-	-	-	-
F- **resolute** (straight to sheet)	53%	65%	45%	51%
G- **nosy** (sheet + RT)	31%	17%	26%	24%

Table 4 - The end-user's behaviour table (frequency distribution)

From these results we can see that the behaviour typology consists of **five typical users**, as follows: curious (4%), indecisive (8%), hesitant (13%), resolute (51%) and nosy (24%). It should be noted that this result - Figure 6 - is proportionally about the same within each category, except that only 5% of internal people (2/49) have disconnected themselves at the beginning of the consultation.

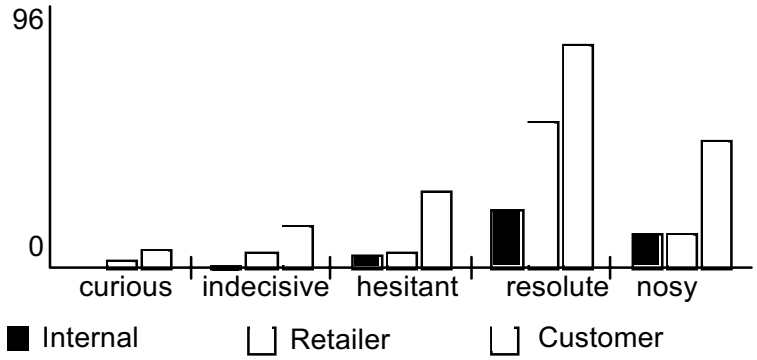

Figure 6 - Crossing : behaviour x user

This crossing, for which the chi-2 test (equal to 14,7 at 6 fd) shows a significant dependence, is still better illustrated by the factorial chart in Figure 7. Let us specify that we had to group together the "curious" and the "indecisive". The geographical analysis of the above diagram, where the "grey" blocks represent the behaviours derived from tracing and the white blocks the user's categories, enables us to better understand the results obtained.

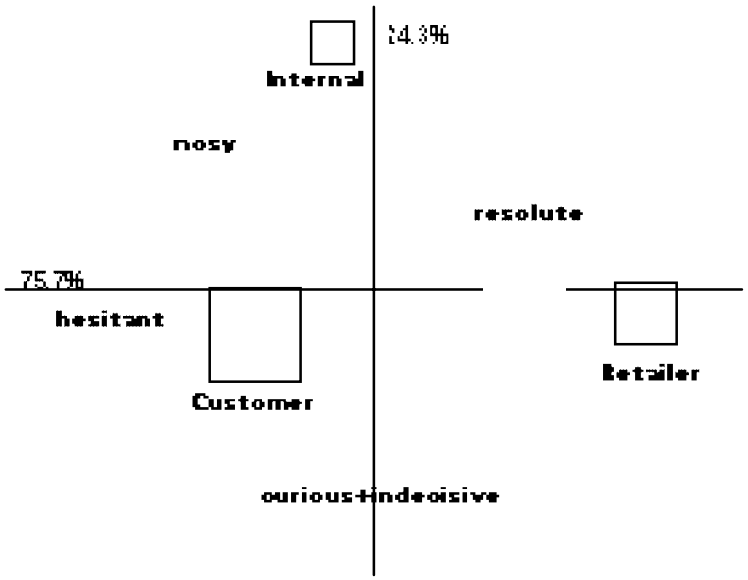

Figure 7 - Factorial chart : behaviour x user

The contrast is essentially that **the three user categories behave differently in comparison with the behaviour table** derived from tracing; retailers and customers, contrasting with each other, also contrast with internal staff. It is then to be noted that there is a marked difference in the way the various user categories use the tool.

It appears that there are very distinct typical profiles: (1) **internal staff** place themselves between the "resolute" (25/49 = 53%) and the "nosy" (15/49 = 31%); (2) **retailers** are essentially "resolute": it is true for 65% (61/95) of the users of this category; even if a few "curious" (4/12) and "indecisive" (7/28) rank among them; (3) **customers**, even if they are well placed in relation to the "resolute" (96/213 = 45%) and the "nosy" (55/213 = 26%), represent the "curious" (8 in a total of 12: 67% of the "curious" are customers), the "indecisive" (19 in a total of 28: 68% of the "indecisive" are customers) and the "hesitant" (35 in a total of 48, i.e. 73%).

This factorial chart helps us demonstrate the difference in the behaviour of the various user categories, which can serve as reference for possible future changes in the tool or even in the strategy of the company (or retailers) concerned, the main target being the behaviour of customers.

The fact that we have not identified any "undecided" users simply means that, having arrived at the beginning of an information selection procedure, all users have managed to go further in using the tool. "Prospectors" have not been identified: it means that all users who have managed to display a list have either selected a sheet (becoming then "resolute or "nosy"), or typed "end-connection" (becoming then "hesitant").

This factorial chart (Figure 7) is principally useful for validating the ***behavioural*** **typology** proposed, since it shows that typology is actually discriminating. In fact, it shows that there is an **internal** category of users (vertical axis) and an **external** one (horizontal axis). It also shows a discrimination between the different typical profiles defined in this analysis.

We can also assert the success of our tool, since 75% of the connections (51% of resolute and 24% of nosy users) have led to successful consultations, with a withdrawal rate of only 12% at the beginning of sessions (4% of curious and 8% of indecisive users). It should be stressed that the 13% of hesitant users have nevertheless had the opportunity to read a solution list.

In the light of this new typology, we shall resume the analysis of tracing, in crossing the "macro-variable" behaviour with: strategy (before or after-sales), information selection criterion (catalogue, keyword or initiated), connection time, access time to information, and consultation resources (images or links). In Table 5, we removed the "undecided" and "prospector" behaviours; as regards access time to information and consultation resources used (links and images), we have considered only the behaviours "resolute" and "nosy".

Variables:	chi-2	fd	result
Behaviour x Strategy	17,33	4	SD
Behaviour x Choice	23,44	6	SD
Behaviour x Connection time	289,62	8	SD
Resolute/Nosy x Access time	4,20	1	SD
Resolute/Nosy x Link	4,70	1	SD
Resolute/Nosy x Image	0,30	1	None

Key : SD = significant dependence (probability >95%), None = no significant dependence (probability < 85%)

Table 5 - Relationship between behaviour and other variables of tracing (chi-2)

The contingency tables relative to the tests should be thoroughly analysed, because they enable us to understand the use of the tool from the identified types. Figure 8 represents the crossing of behaviour with consultation strategy: for the curious (8/12), indecisive (20/28) and hesitant (32/47) users, proportions are nearly balanced (70% before-sales and 30% after-sales), while 81% of the resolute users (148/183) select before-sales information and 43% of the nosy users (37/86) select after-sales information.

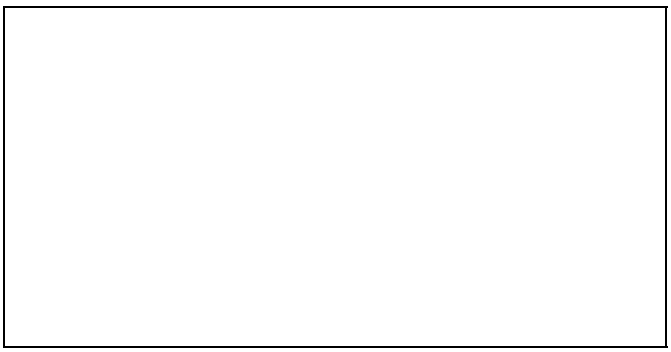

Figure 8 - Crossing : behaviour x strategy

In the crossing of behaviour with the information selection criterion used, the curious users have been removed, since - by definition - they do not even manage to choose a criterion. Figure 9 shows that among hesitant, resolute and nosy users, about 50% use the "catalogue" option and 30% use "keyword" as a model for searching and selecting the desired information. The "initiated" option perhaps accounts for the fact that some users have been described as "indecisive": 43% of those have used the "initiated" option (12 out of 28).

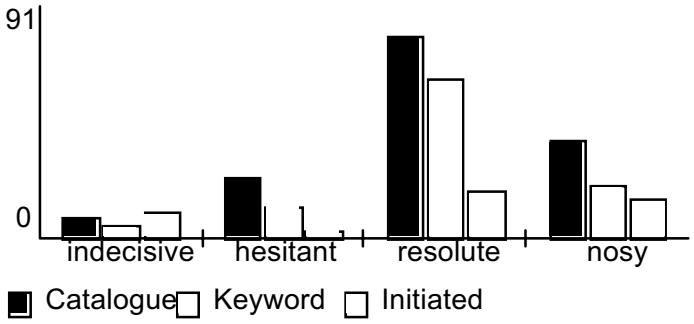

Figure 9 - Crossing : behaviour x choice

Access time to information (time needed from the choice of an information selection criterion to the opening of an information sheet) ranges essentially between 30 and 60 seconds: one notices that 29% (25/86) of the nosy users need more than 60 seconds, which is the case with only 18% (33/183) of the resolute users. Globally, 78% of successful consultations (211/269) need between 30 and 60 seconds to arrive to a sheet.

As regards the length of each consultation, Figure 10, it appears that all curious users (those who just glanced at the application) have been connected less than four minutes. 79% (68/86) of the nosy users are naturally connected more than six minutes, they represent 68% of the connections of that length. Resolute users represent 78% of the consultations between four and six minutes (133/171), which represents 73% of the resolute users.

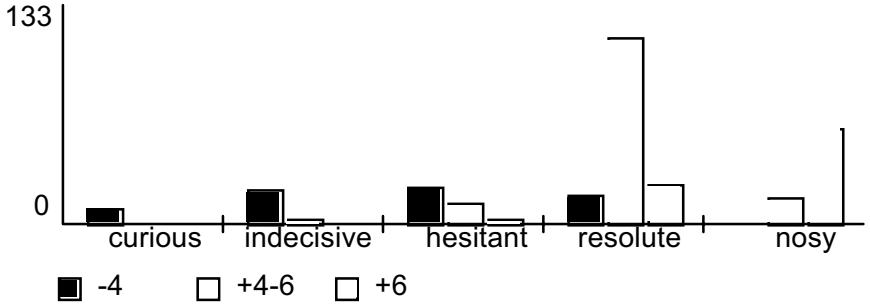

Figure 10 - Crossing : behaviour x connection time

With regard to the possibility to consult information linked to the relevant information sheet, 66% (121/183) of the resolute and 79% (68/86) of the nosy users have made use of it: the part played by each of these user categories accounts for this small difference in using this consultation resource.

Finally, as regards the use of illustrations for a product sheet, although figures representing the use of images are slightly higher, there is no clear discrimination between percentages: about 50% of each type (resolute and nosy) use it.

As regards customers, it appears that one should consider to modify the DSS functionality, since 29% are either curious, indecisive or at best hesitant. Research in after-sales is also not very used (28%), which necessitates a thorough estimation of this service.

Access time, total connection time, links and illustrations are rather satisfactory. On the other hand, even if the access modes "catalogue" and "keyword" have a good utilisation rate, a problem related to the "initiated" mode is identified, since we note that this research mode is related to indecisive users. We should consider to modify/adapt or even to remove the research option "initiated", as well as we should consider a new functionality taking into account the specific needs of customers, keeping the present functionality for retailers and internal staff. In fact, these statements point out a functional dichotomy: customers and retailers/internal staff.

The tracing has enabled us to identify five typical users, having each features associated to a qualifying adjective. The importance of the "resolute" and "nosy" categories shows the success (at a 75% rate) of the tool with users. This analysis has enabled us to understand their behaviour: i.e. their choices (before or after-sales; catalogue, keyword or initiated), as well as the time needed to obtain information (access time) and the total connection time. We can also note how each typical user made or did not make use of the available consultation resources (links and illustrations).

The analysis of tracing has enabled us to define a behaviour table (Table 3) which can be used as a basis for other studies, in order to cross the behaviour dimension with other analysis dimensions, such as the functional dimension. This makes it possible to understand and above all to identify the problems linked to the use of a DSS, allowing to focus the action of the organization implied in solving these problems. This is in fact an original analysis dimension regarding end-users actions.

7. Conclusions

We now wish to highlight the **contributions** of our study and its potential **beneficiaries** (7.1). We shall then emphasize its **limits** and propose some **research paths**, in the continuity of the work carried out (7.2).

7.1 - The contributions of this research

The main contributions of this research apply to (1) design and implement a method integrated to a telematic server for observing its users, as well as (2) define a behavioural dimension for a users typology. We are therefore in a position to bring two systems of assessment to management sciences.

The first contribution is at the core of the definition of an **assessment method**, on account of its originality: the automated assessment of a decision support tool through storage and analysis of tracing. The method used (Section 4) takes into account an end-user typology, their abilities and formation (data processing competence dimension: non-expert user, expert user or data processing expert) and their environment (functional dimension: customer, retailer or internal staff).

We think that this approach, stemming from an in-depth conceptual research and based on a development/research, constitutes a significant contribution for both scientists and developpers (firms or experts) in charge of designing, implementing, or assessing computer-controlled tools in organizations. Finally, two major new possibilities are offered: (1) the automated and implicit collection of data, through recording all actions done by each end-user during each system consultation, characterizes **tracing**; it allows *transparency* (and therefore the absence of biases) in data collection, in addition to sparing researchers or managers the data collection stage, since data is recorded in an appropriate way to be subsequently used; and (2) different typical users are taken into account (in considering the functional and data processing competence dimensions) and a new **dimension** is proposed.

The second contribution concerns the results achieved. We have set out, in Section 6, an analysis of the impact of our tool in the different users groups involved inside and outside the organization. The conceptual and valid formalization of the architecture ("H") of a data-oriented application (Section 5) also leads us to propose it as a reference. At last, our study enables men of action to efficiently carry out tasks related to information management through data communication methods: it offers then a model, based on *the practice of theory*, for design, development, implementation and assessment of an information managament tool, which is modern and efficient .

We have analysed in the most in-depth way the data which we were able to collect, and we have succeeded in establishing a **behavioural typology** (Tables 3 and 4): we should not forget that this constitutes not only the principle on which the assertion of the success of our tool is based, but above all a reference framework for people working in this field.

We can state - taking as our basis the controls described in the previous section - that the tools improving the information stage are considered as efficient and relatively easy to use, they play a major part in improving the decision-making dynamics. It is therefore undeniable that **having a telematic tool can simplify the information process, and consequently, make the decision process easier for any end-user**.

Let us also stress that, even if the device used to verify our propositions is Minitel (a terminal offering only the essential resources in teleinformatics), we had the occasion to verify more general aspects of human behaviour and on the end-user - system interaction.

We must stress the fact that it is a contribution for the "real time society": a real time and remote decision recognizes the significance of the response time as a criterion by which the decision and assessment value of the decision maker can be enhanced. On the other hand, the present competitive pressure imposes short times: it is therefore of great importance to have an efficient tool in this field. However, it is clear that the tool proposed here cannot be considered as one more system, but it must be designed as an integral part of the information system in the organization.

7.2 - Limits of this research and orientations for future research

Because this research is carried out in the "university-business" framework, i.e. an applied research, it implies a specific logic which the researcher must take into account: business is essentially pragmatic and requires practical and short-term results, while criticizing the university for being too theoretical. We have done our utmost to satisfy both of them.

It is essential that the researcher be involved in the tool development cycle right from the design stage, so that the automatic tracing procedures can be defined and integrated into the tool, while maintaining its transparency for end-users and the judiciousness of the assessment.

With regard to the analysis of data collected through tracing, it should be stressed that we have grouped users by segments (functional dimension), i.e. in the three categories defined for the analyses, although we had the means to follow the behaviour of each user individually.

We have studied a situation related to the first stage of the decision process (according to SIMON's model), but other studies could be applied to the design and choice stages. It should therefore be useful to search for observation protocols - in real situation, as we did here - for a better understanding of the later stages of the decision process.

In order to benefit those who intend to make studies based on design and assessment of a decision support tool, we wish to draw attention to the methodological context concerning this type of study. The success of such a research depends on the systematic investigation into development, setting up, use and impact of an application in an organizational environment. The technical dimensions involved (research-development) are assessed in their purposes: use (research-empirics). Each situation needs the assessment method to be adapted: in the case where a DSS has only an internal level of use, the task of collecting data is made easier.

Finally, all this constitutes a reference framework which is especially useful to people working with systems assessment, and having available such a behavioural typology (obtained by analysing the automated tracing) enables them to better understand the reactions of the various end-users.

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