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# Positioning analysis using knowledge-based support

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We present knowledge-based support for positioning analysis applications. It is shown how knowledge about user wishes, positioning analysis objectives, and the input/output behavior of methods can be combined in order to provide substantial support for the analysis of survey data. We describe how such knowledge is represented and processed in the knowledge-based marketing data analysis system WIMDAS-PS (**WI**ssensbasiertes **M**arketing-**D**aten**A**nalyse-**S**ystem zur **P**ositionierungs- und **S**egmentierungsanalyse) and use a sample consultation session for demonstration purposes.

**Keywords:** Knowledge-based support, marketing and market research, positioning analysis.

## 1. Introduction

Positioning analysis is an important marketing area, in which the assessment of competitive structures (with respect to objects under consideration as, e.g., brands, firms) and the determination of promising features (for new objects or those for which repositioning is desired) are main research issues. For these and related purposes survey data from respondents have to be analyzed by (combined) application of available methods from data analysis and OR (see, e.g., Green and Krieger [19], Sudharsan et al. [23]). Here, problems with respect to selection of data and application of methods can arise (see, e.g., Böckenholt et al. [6]).

Within the WIMDAS (**WI**ssensbasiertes **M**arketing-**D**aten**A**nalyse-**S**ystem)-project, researchers from Hamburg, Karlsruhe, and Mannheim (see, e.g., Baier and Gaul [4, 5], Gaul et al. [16]) have developed support concepts for problems of this kind and implemented different versions of decision support systems for knowledge-based marketing data analysis. An overview is given in Gaul and Schader [15].

In the following, we sketch WIMDAS-PS (where the suffix PS stands as a reminder for the application areas of positioning and segmentation analysis). In this paper, we confine ourselves to positioning analysis, especially to knowledge about user wishes, about positioning analysis objectives, and about the input/output behavior of methods with respect to optimal positioning and data analysis. We describe how the knowledge-based system combines this knowledge in order to support method selection and to provide desired results. A sample consultation session with WIMDAS-PS is used for demonstration purposes.

## 2. Knowledge to handle positioning analysis

Explanations with respect to the (different kinds of) knowledge implemented to support potential users make up an important part within the description of a knowledge-based system. In the next subsections, only some selected aspects can be reported.

### 2.1. KNOWLEDGE ABOUT USER WISHES AND POSITIONING ANALYSIS OBJECTIVES

Various approaches for positioning analysis have been developed to provide substantial support for users confronted with positioning problems (see, e.g., Green and Krieger [19]). In order to facilitate the user-system interaction within WIMDAS-PS, established knowledge about interrelations between user wishes and positioning analysis objectives has to be made available: Concerning user wishes, four application tasks ("Generating Positioning Options", "Assessing the Current Positioning", "Forecasting the Likely Impact of a Positioning Strategy", and "Determining the Desired Positioning") can be separated (see, e.g., Wind [26]). Within each application task, questions and problems can arise that can be supported by analytic concepts related (from a methodological point of view) to positioning analysis objectives, like, e.g., "Generating Preferred Feature Combinations", "Generating Preferred Map Positions", "Part Worth Analysis", "Perceptual Mapping", or "Preference Mapping".

Figure 1 gives an impression how these hierarchical connections between user wishes and positioning analysis objectives (both indicated by respective arrows) are implemented in the knowledge base of WIMDAS-PS. Although only a part of the relations between user wishes and positioning analysis objectives are shown, one can see that, e.g., the positioning analysis objective "Preference Mapping" is linked to the application task "Assessing the Current Positioning" or that the application task "Generating Positioning Options" and the positioning analysis objective "Generating Preferred Map Positions" are connected.

For positioning analysis objectives presentation forms like diagrams, maps, or dendrograms are used to facilitate the communication of results. In the description of the consultation session we give an example how results with respect to the positioning analysis objective "Preference Mapping" can be displayed by presenting a joint space via scaling methods (figure 7) and, additionally, by applying cluster analysis as portrayal of hierarchical structures within the set of objects and/or subjects.

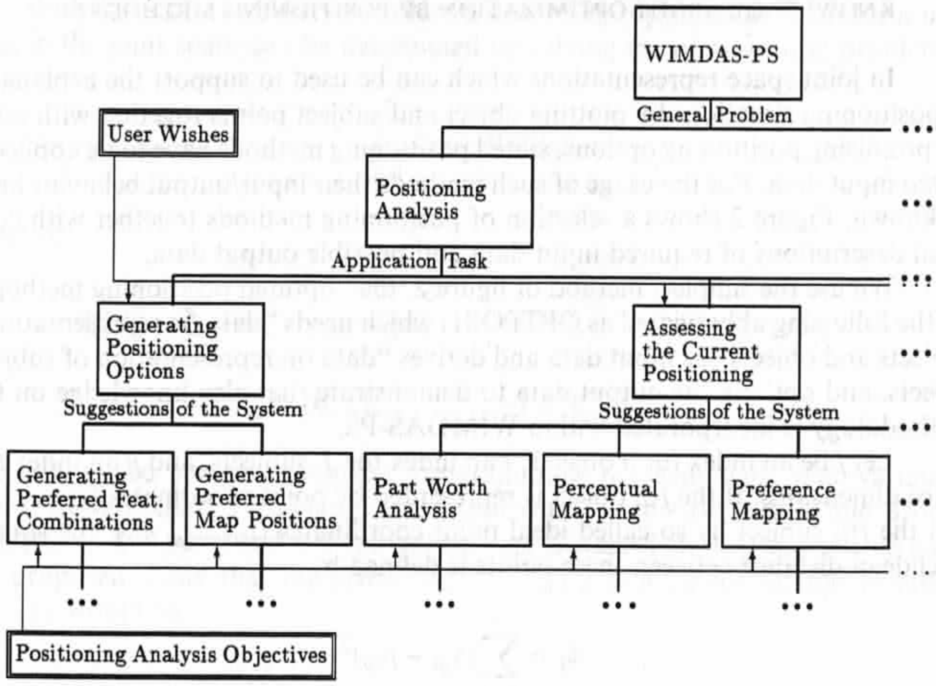


Figure 1. Selected user wishes and positioning analysis objectives in WIMDAS-PS.

| | *Input Data 1* | *Input Data 2* | *Input Data 3* | *Output Data* | *Reference* |
|---|---|---|---|---|---|
| optimal positioning method 1 (OPTPOS1) | data on representation of subjects and objects | | | data on representation of subjects, objects, and options | Albers and Brockhoff [2], Gavish et al. [17] |
| optimal positioning method 2 (OPTPOS2) | data on preference of attributes and levels | data on attachment of objects, attributes, and levels | | data on attachment of objects, options, attributes, and levels | Zufryden [27], Kohli and Krishnamurti [21] |
| optimal positioning method 3 (OPTPOS3) | data on representation of subjects and objects | data on partial return from attributes | | data on representation of subjects, objects, and options | Bachem and Simon [3], Albers [1] |
| optimal positioning method 4 (OPTPOS4) | data on preference of attributes and levels | data on attachment of objects, attributes, and levels | data on partial return from attributes and levels | data on attachment of objects, options, attributes, and levels | Green et al. [18], Dobson and Kalish [14] |

Figure 2. Colloquial descriptions of the input/output behavior of selected positioning methods.

## 2.2. KNOWLEDGE ABOUT OPTIMIZATION BY POSITIONING METHODS

In joint space representations which can be used to support the explanation of positioning situations by plotting object and subject points together with points for promising positioning options, suited positioning methods have to be applied on suited input data. For the usage of such methods their input/output behavior has to be known. Figure 2 shows a selection of positioning methods together with colloquial descriptions of required input data and possible output data.

We use the simplest method of figure 2, the "optimal positioning method 1" (in the following abbreviated as OPTPOS1) which needs "data on representation of subjects and objects" as input data and derives "data on representation of subjects, objects, and options" as output data to demonstrate that also knowledge on OR-methodology is incorporated within WIMDAS-PS:

Let $j$ be an index for $n$ objects, $t$ an index for $T$ subjects, and $p$ an index for $r$ space dimensions. If the $j$th object is represented by point coordinates $(x_{j1}, \ldots, x_{jr})$ and the $t$th subject by so-called ideal point coordinates $(\mu_{t1}, \ldots, \mu_{tr})$, the squared Euclidean distance between these points is defined by

$$d_{tj} = \sum_{p=1}^{r} (x_{jp} - \mu_{tp})^2 \tag{1}$$

and can be used as a measure with respect to the preference of the $t$th subject for the $j$th object. In this sense the $j$th object is preferred to the $k$th object by the $t$th subject whenever

$$d_{tk} - d_{tj} \geq 0 \tag{2}$$

holds.

Under certain assumptions (see, e.g., the early paper by Shocker and Srinivasan [22]) a new object with point coordinates $(x_{01}, \ldots, x_{0r})$ will be preferred to the $k$th object whenever

$$d_{tk} - \sum_{p=1}^{r} (x_{0p} - \mu_{tp})^2 \geq 0 \tag{3}$$

applies. Consequently, the new object is assumed to be preferred to all established objects whenever

$$d_{tk} - \sum_{p=1}^{r} (x_{0p} - \mu_{tp})^2 \geq 0, \quad \forall k = 1, \ldots, n, \tag{4}$$

is satisfied.

With $\xi_1, \ldots, \xi_T$ as binary variables a promising (optimal) location for a new object in the joint space can be determined by solving the optimization problem

$$\sum_{t=1}^{T} \xi_t \rightarrow \max! \tag{5}$$

subject to

$$\begin{aligned} \xi_t(d_{tk} - \sum_{p=1}^{r}(x_{0p} - \mu_{tp})^2) \geq 0, & \quad \forall t = 1, \ldots, T, k = 1, \ldots, n, \\ \xi_t \in \{0, 1\}, & \quad \forall t = 1, \ldots, T. \end{aligned} \tag{6}$$

This is a mixed integer nonlinear programming problem with real variables $x_{01}, \ldots, x_{0r}$ and binary variables $\xi_1, \ldots, \xi_T$ for which geometric (Albers and Brockhoff [2]) as well as point and line search (see, e.g., Gavish et al. [17]) approaches have been proposed. Note that for given $(x_{01}, \ldots, x_{0r})$ a best choice for the variables $\xi_1, \ldots, \xi_T$ would be

$$\xi_t = \begin{cases} 1 & \text{if } d_{tk} - \sum_{p=1}^{r}(x_{0p} - \mu_{tp})^2 \geq 0 \quad \forall k = 1, \ldots, n, \\ 0 & \text{otherwise;} \end{cases} \quad \forall t = 1, \ldots, T. \tag{7}$$

Because of computational reasons we have implemented a Gavish/Horsky/Srikanth-like version in the method base of WIMDAS-PS.

### 2.3. KNOWLEDGE ABOUT DATA ANALYSIS BY SCALING METHODS

As depicted in figure 2, OPTPOS1 requires input data which describe joint space representations of subjects and objects. Such data can be viewed as output data yielded by application of scaling methods (see, e.g., Cooper [10]). Figure 3 provides – like figure 2 – only a small selection of scaling methods, again together with colloquial descriptions of required input data and possible output data as well as some references.

Now, we use a special external analysis version of the so-called wandering ideal point model (in the following abbreviated as WANID5) for demonstration purposes. This model is an own development (see Böckenholt and Gaul [7], DeSoete et al. [13]) whose output data can be taken as input data for OPTPOS1. Additional to the notations for subjects, objects, and space dimensions a probabilistic generalization for the usage of ideal points is employed. (Mean) ideal point coordinates for the $t$th subject $(\mu_{t1}, \ldots, \mu_{tr})$ may be superimposed by random

| | Input Data 1 | Input Data 2 | Output Data | Reference |
|---|---|---|---|---|
| external multidimensional unfolding method 1 (GENFOLD1) | data on representation of objects | data on dissimilarity between objects of two modes | data on representation of objects of two modes | DeSarbo and Rao [11, 12] |
| weighted multidimensional scaling method 1 (INDSCAL1) | data on dissimilarity between objects | | data on representation of objects | Carroll and Chang [9] |
| internal wandering ideal point model, method 1 (WANID1) | data on paired comparisons between objects | | data on representation of subjects and objects | Böckenholt and Gaul [7], DeSoete et al. [13] |
| external wandering ideal point model, method 5 (WANID5) | data on representation of objects | data on paired comparisons between objects | data on representation of subjects and objects | Böckenholt and Gaul [7], DeSoete et al. [13] |

Figure 3. Colloquial descriptions of the input/output behavior of selected scaling methods.

error, i.e. the $p$th coordinate for the $t$th subject is described by

$$\mu_{tp} + \epsilon_{tp} \quad \text{with} \quad \epsilon_{tp} \sim \mathrm{N}(0, \lambda_{tp}^2), \quad \mathrm{cov}(\epsilon_{t_1p_1}, \epsilon_{t_2p_2}) = 0, \tag{8}$$

while point coordinates for the $j$th object $(x_{j1}, \ldots, x_{jr})$ remain deterministic.

A reason for this generalization may be due to the fact that subjects are uncertain when making preference judgements.

Using

$$D_{tj} = \sum_{p=1}^{r} (x_{jp} - (\mu_{tp} + \epsilon_{tp}))^2 \tag{9}$$

as random equivalent of the deterministic notation (1), now, the probability, that the $j$th object will be preferred to the $k$th object by the $t$th subject, is of interest.

With regard to the model assumptions (8) and (9) this probability is given by

$$p_{tjk} = Pr(D_{tk} - D_{tj} \geq 0)$$

$$= \Phi\left(\frac{\sum_{p=1}^{r}(2(x_{jp} - x_{kp})\mu_{tp} + (x_{kp}^2 - x_{jp}^2))}{\sqrt{4\sum_{p=1}^{r}\lambda_{tp}^2(x_{jp} - x_{kp})^2}}\right), \tag{10}$$

where $\Phi$ denotes the standard normal distribution function and $\lambda_{11}^2, \ldots, \lambda_{Tr}^2$ are the respective random error variances from (8).

In order to fit this approach to observed paired comparisons data as input data, various methods can be applied, e.g., the "external wandering ideal point model, method 5". Here, external analysis means, that the point coordinates for the objects are externally restricted to prespecified values with respect to fixed space dimensions. Then, the unknown parameters to be estimated in (10) reduce to the (mean) ideal point coordinates $\mu_{11}, \ldots, \mu_{Tr}$ and the random error variances $\lambda_{11}^2, \ldots, \lambda_{Tr}^2$.

Using maximum likelihood estimation with respect to the unknown parameters and assuming independence wherever it is needed,

$$L = \prod_{t=1}^{T} \prod_{j=1}^{n} \prod_{k=j+1}^{n} p_{tjk}^{n_{tjk}} (1 - p_{tjk})^{(R_{tjk} - n_{tjk})} \tag{11}$$

is the essential part of the likelihood function. $R_{tjk}$ denotes the number of times that the $j$th and the $k$th object are shown to the $t$th subject while $n_{tjk}$ is the number of times that the $j$th object was preferred to the $k$th object by the $t$th subject. For parameter estimation, the negative log-likelihood function

$$- \log L = -\sum_{t=1}^{T} \sum_{j=1}^{n} \sum_{k=j+1}^{n} (n_{tjk} \log p_{tjk} + (R_{tjk} - n_{tjk}) \log(1 - p_{tjk})) \tag{12}$$

is minimized by means of nonlinear programming. Here, we have another example which demonstrates that knowledge on OR-methodology (constrained optimization) is needed within WIMDAS-PS. Note that figures 2 and 3 already show that (parts of) required input data for one method can be yielded as output data from other methods. How sequences of applications of methods can be used for the solution of positioning problems is explained in the next section.

## 3. How knowledge is represented and processed in WIMDAS-PS

### 3.1. TAILORING THE ARCHITECTURE

The knowledge-based system WIMDAS-PS has been implemented on SUN®-workstations. A modular approach has been chosen which allowed an iterative design of the system and its single components, a dialog component, a knowledge management component, a method management component, and a data management component.

The dialog component, which uses the OPEN LOOK® GUI (Graphical User Interface) ([24, 25]) to ensure consistency with other applications available in the OPEN LOOK workspace, manages the user-system interaction. It also contains routines for converting outputs of various data analysis and optimization methods into a format which is suited for graphical presentation (see Hantelmann [20]). An impression of how the dialog component works and what kind of dialog style is used will be given in the following section, where a consultation of WIMDAS-PS is sketched.

The knowledge management component incorporates necessary modules and interfaces to interact with the knowledge base. The inference engine was developed using IF/PROLOG. One of its tasks is to construct sequences of applications of methods which have to be put together to achieve results according to specified user wishes and available survey data. Rules describe the input/output behavior of the data analysis and optimization methods included in the method base of WIMDAS-PS.

The method management component provides access to the methods available in the method base. Various methods for aggregating and transforming data, for performing cluster analysis, conjoint analysis, factor analysis, multidimensional scaling, and regression analysis, and, of course, for optimization belong to the method base. An application interface controls the applications of methods during the analysis process.

The data management component contains the database and provides possibilities to store and retrieve raw and derived data. Additionally, information about the surveys and the different kinds of data has to be administered. Note that colloquial as well as formal (see the next subsection) data descriptions together with the concrete data have to be available during the inference processes and the method applications.

### 3.2. COMBINING DATA AND METHODS

In the following, we use the term "data array" as synonym for a logical storage unit containing concrete data arranged as multidimensional tables together with colloquial and formal descriptions which explain and describe the concrete data. While in figures 2 and 3 colloquial descriptions were sufficient, now, some formal descriptions are needed in order to perform knowledge-based data analysis. In WIMDAS-PS, applicability of methods to data arrays is expressed by means of so-called data array characterizations for the input as well as the output data arrays that extend data array taxonomies given by Carroll and Arabie [8], Böckenholt et al. [6], and Baier and Gaul [4, 5].

For demonstration purposes, again, the just described method WANID5 is used. Figure 4 shows the formal description of the input/output behavior of WANID5 in terms of data array characterizations in PROLOG-syntax. Input data array characterizations as well as the output data array characterization are expressed using a predicate "data" with 17 arguments. As can be seen from figure 4, arguments are named by "description", "survey", "number of modes", "dimension", "way1", ..., "way6", "data type", "scale type", "scale min", "scale max", "relation type", "conditionality", and "metric". An application of

```
data( [['WANID5 external wandering ideal point model',
        ['data on representation of ',Object_type1,' and ',Object_type2]],
      Description1, Description2]                            % description
     ,Survey                                                 % survey
     ,'2'                                                    % number of modes
     ,'2'                                                    % dimension
     ,[Object_type1,Object_type2]                            % way1
     ,[Object_type3]                                         % way2
     ,'not defined'                                          % way3
     ,'not defined'                                          % way4
     ,'not defined'                                          % way5
     ,'not defined'                                          % way6
     ,'representation'                                       % data type
     ,'ratio'                                                % scale type
     ,'not defined'                                          % scale min
     ,'not defined'                                          % scale max
     ,'pair'                                                 % relation type
     ,'not defined'                                          % conditionality
     ,'not defined' )                                        % metric
:-data( Description1                                         % description
     ,Survey                                                 % survey
     ,'2'                                                    % number of modes
     ,'2'                                                    % dimension
     ,[Object_type2]                                         % way1
     ,[Object_type3]                                         % way2
     ,'not defined'                                          % way3
     ,'not defined'                                          % way4
     ,'not defined'                                          % way5
     ,'not defined'                                          % way6
     ,'representation'                                       % data type
     ,'ratio'                                                % scale type
     ,'not defined'                                          % scale min
     ,'not defined'                                          % scale max
     ,'pair'                                                 % relation type
     ,'not defined'                                          % conditionality
     ,'not defined' ),                                       % metric
  data( Description2                                         % description
     ,Survey                                                 % survey
     ,'2'                                                    % number of modes
     ,'3'                                                    % dimension
     ,[Object_type1]                                         % way1
     ,[Object_type2]                                         % way2
     ,[Object_type2]                                         % way3
     ,'not defined'                                          % way4
     ,'not defined'                                          % way5
     ,'not defined'                                          % way6
     ,'preference'                                           % data type
     ,'ordinal'                                              % scale type
     ,'1'                                                    % scale min
     ,'1'                                                    % scale max
     ,'pair'                                                 % relation type
     ,'not defined'                                          % conditionality
     ,'not defined' ).                                       % metric
```

Figure 4. Formal description of the input/output behavior of a sample method in PROLOG-syntax.

WANID5 is possible and leads to an output data array of the form described in the upper part of figure 4 if two data arrays are available with data array characterizations depicted in the lower part of figure 4.

WANID5 needs two input data arrays, an input data array with, e.g., "2" as "number of modes", "2" as "dimension", and "representation" as "data type" ("data on representation of objects", see figure 3) as well as an input data array with, e.g., "2" as "number of modes", "3" as "dimension", and "preference" as "data type" ("data on paired comparisons between objects", see figure 3). An application of WANID5 would lead to an output data array with "2" as "number of modes", "2" as "dimension", and "representation" as "data type" ("data on representation of subjects and objects", see again figure 3). Rules of the kind as depicted in figure 4 are stored in the knowledge base of WIMDAS-PS for every method contained in the method base of the system.

In a similar way, facts of the predicate "data" indicate that data arrays with data array characterizations according to the respective 17 arguments are available in the system's database. Special importance deserves the argument "description" of the predicate "data": It is used to collect information how the described data array was derived.

### 3.3. FORMING SEQUENCES OF APPLICATIONS OF METHODS

Figure 5 shows a sample flow chart for selected data arrays, methods, and positioning analysis objectives and illustrates how suited sequences of applications of methods can be formed using the knowledge described earlier. Methods are represented by ellipses. Rectangles are used for data arrays. Desired results, respectively positioning analysis objectives (see figure 1), are depicted by parallelograms. Methods and their input data arrays are connected by lines. Arrows are used to point to the output data arrays of methods which may be interim results needed as input data arrays for other methods. Note that WIMDAS-PS controls modular knowledge about the adequacy of such connections, since the above mentioned rules concerning the input/output behavior of methods as well as the facts concerning the availability of survey data are stored in the knowledge base.

In order to create suited sequences of applications of methods, different kinds of information are required. Available surveys and data arrays can be provided by the data management component which passes such information to the dialog component for selection purposes. Survey and data array selections are obtained by user-system interaction. Using respective knowledge (see figure 1), the system internally maps user wishes to positioning analysis objectives (at the bottom of figure 5) which are specified as a goal for the predicate "data".

Starting with the selected data arrays the inference engine can now be activated from the dialog component in order to create feasible combinations of methods which are suited for the specified goal. Using the system's knowledge base, the inference engine creates suited sequences of applications of methods. As

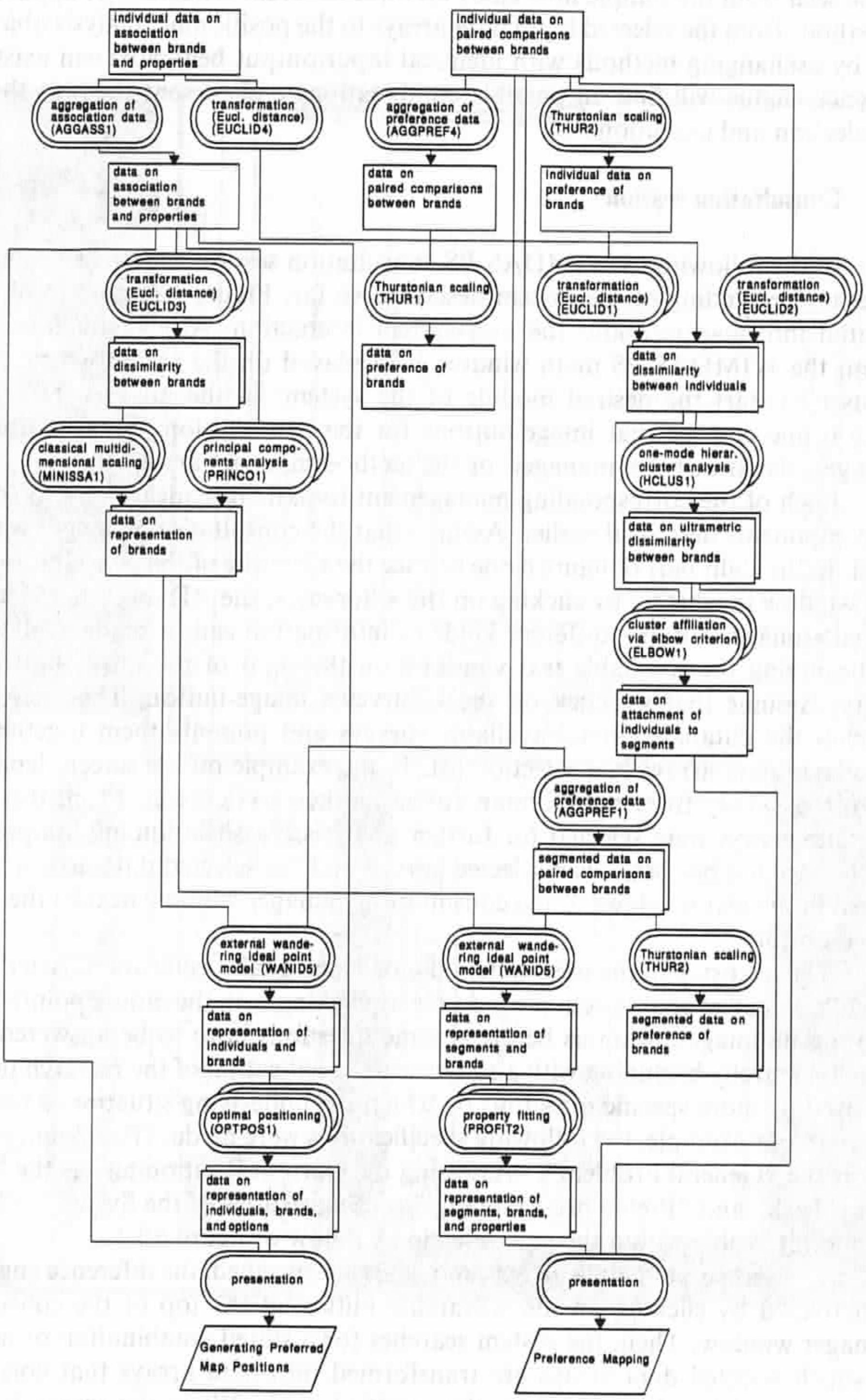


Figure 5. Sample flow chart for selected data arrays, methods, and objectives.

can be seen from the sample flow chart multiple different sequences of applications of methods from the selected input data arrays to the positioning analysis objectives (e.g. by exchanging methods with identical input/output behavior) can exist. The inference engine will find all possible combinations and present them to the user for selection and execution.

## 4. Consultation session

In the following, a WIMDAS-PS consultation session is sketched to allow a better understanding of the system described so far. Figure 6 is used to illustrate essential information about the user-system interaction. After activation of the system the WIMDAS-PS main window is displayed on the screen which enables the user to start the desired module of the system: In the upper left corner of figure 6 one can see that image-buttons for the consultation manager, the data manager, the knowledge manager, or the method manager are available.

Each of the corresponding management toolkits provides access to some of the components described earlier. Assume that the consultation manager was activated. In the right part of figure 6 one can see the structure of the consultation manager window in which – by clicking on the <Survey>, the <Data Array>, and the <Goal> image-button – different kinds of information can be made available. In the beginning the scrollable text windows on the right of the image-buttons are empty. Assume that we click on the <Survey> image-button. The system now searches the database for all available surveys and presents them together with the related data arrays in a selection list. In the example on the screen depicted in figure 6 a survey from the German coffee market was chosen. From the survey two data arrays were selected for further analysis: "association.ind.bra.pro" and "preference.ind.bra.bra". The selected survey and the selected data arrays are displayed in the text windows of the consultation manager window next to the related image-button.

The next step in the user-system dialog is the goal specification. After activation of a so-called goal selection window – by clicking with the mouse pointer on the appropriate image-button as before – some questions have to be answered which form a hierarchy beginning with a rather wide specification of the research problem followed by more specific questions by which the underlying situation is narrowed down. In our example, the following specifications were made: "Positioning Analysis" as the "General Problem", "Assessing the Current Positioning" as the "Application Task" and "Preference Mapping" as "Suggestions of the System". (The last selection is visible within the goal selection window of figure 6.)

Now, as surveys, data arrays, and goals are specified, the inference engine can be activated by clicking on the <Search> button at the top of the consultation manager window. Then, the system searches for a suited combination of methods by which selected data arrays are transformed into data arrays that correspond to the user wishes determined by the specified goals. When the search has been

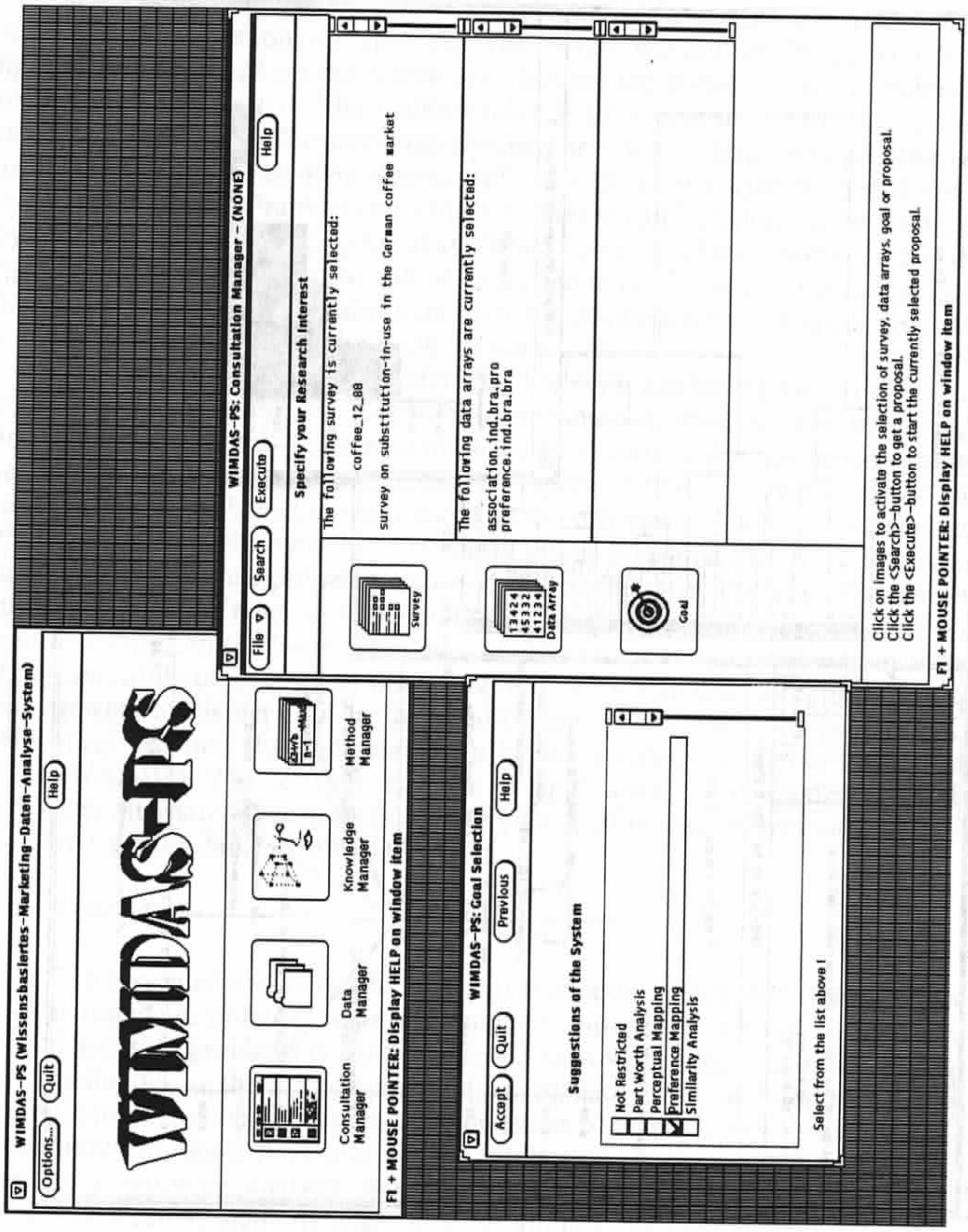


Figure 6. Information about the WIMDAS-PS user-system dialog.

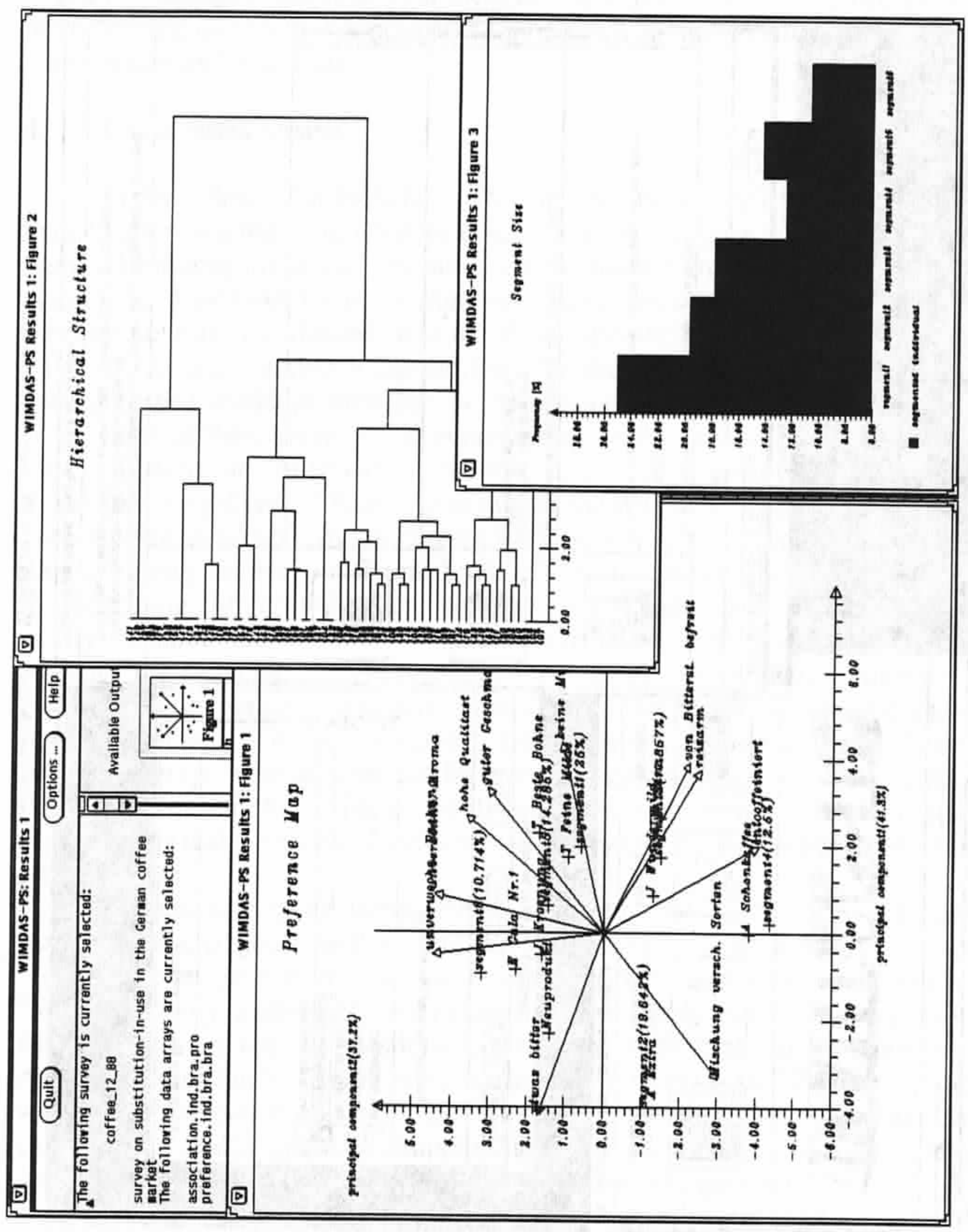


Figure 7. Some graphical results of the consultation session.

successful, a selection among the available sequences of applications of methods can be made and an execution of the selected alternative can be performed by clicking on the <Execute> button also located at the top of the consultation manager window.

Figure 7 shows the screen after completion of the execution of the selected sequence of applications of methods. The results window in the upper left of figure 7 has appeared on the screen and denoted the successful accomplishment of the selected alternative. The results window is structured similar to the consultation manager window. The previously selected surveys, data arrays and goals as well as the executed sequence of applications of methods are displayed in scrollable text windows on the left. Graphical presentation of results and a report can be displayed by choosing from the scrolling-list of available results (graphics, reports, etc.) on the right of the results window. As can be seen from figure 7, some of the results have been activated: a cloud-chart down on the left, a dendrogram at the upper right and a histogram down on the right corner of the screen.

The cloud-chart shows a preference map with products (objects) and ideal points of segments (subjects). As can be seen from the preference map, the perceptual dimensions for this representation have been derived from principal components analysis. Here, a two-dimensional representation (as over 75% of the variance can be explained in the reduced space) has been chosen by the technique PRINCO1. The application of the property fitting technique PROFIT2 has led to an embedding of some property vectors (which sufficiently fulfilled a fit criterion) into the preference map. A segmentation of respondents into six segments has been performed on the basis of paired comparisons data with relative frequencies of segment affiliation shown in the histogram. The hierarchical structure used for the segmentation is depicted in the dendrogram. Ideal points of segments have been integrated into the preference map by the external wandering ideal point model WANID5. The selected sequence of applications of methods – together with other alternatives – can be found in figure 5. Of course, all methods depicted in figure 5 are available in WIMDAS-PS.

## 5. Conclusions

The presented knowledge-based decision support system WIMDAS-PS provides assistance in different ways, e.g., support with respect to various data and method selection problems is made available, hints with respect to different solution possibilities of the applications under study are given, and comparisons of results from alternative sequences of applications of methods are possible. As the presentation of selected results of a consultation session of the system has revealed, positioning analysis was combined with segmentation activities for which classification methods (e.g., different kinds of cluster analysis) have to be included in the method base. Although knowledge about segmentation (and methods to handle segmentation problems) is obviously incorporated in WIMDAS-PS a restriction to positioning analysis questions was met for this paper.

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