SOFTWARE EKOS 2000 IN FOOD HYGIENE RESEARCH AND CONTROL

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SUMMARY

The result of three year work on the development of EKOS 2000 is a working application developed as distributed data collecting system with input logic filters and output data crunching methods. Computing speed and space optimizations are implemented. The user interface for data crunching was created in several forms : data to matrix, matrix to statistics, data to groups, groups to statistics. After the first year of its application into the practice in 1993, EKOS 2000 already had a data collection of 60670 results from more than 150 different types of analyses got on 22438 different samples (18829 raw and final products of food samples, 810 water samples and 2799 environmental samples). 2436 food samples, 127 water samples, and 603 environmental samples were qualified as unsuitable according to our official regulations. The most important point is that all these pieces of information are connected with more than 400 food producing companies including those from abroad, with over 300 food trade companies, and more than 200 different kinds of foodstuffs. Now, creating of the reports and evaluating the risks for the specific companies or for the specific foodstuffs is very simple and the reports can be sent daily, weekly or monthly to all official veterinary surgeons in Slovenia. The program offers the possibility to treat data from different levels which is mandatory for monitoring the situation regarding the results obtained in the laboratory, and to create computer simulations and models in the field of food hygiene.

Introduction

Department of Food hygiene of Veterinary faculty in Ljubljana in cooperation with Software engineering company A&Z worked three years on Software program EKOS 2000 version VETE. The systematic control parallel with the inspection control of the food safety, food hygiene and food quality is practiced in Slovenia for more than twenty years (Anon., 1987). The difference between the inspection and the systematic control is that the trading process doesn't stop for the food under the systematic control (Florjanc, 1991 and Florjanc, 1993). The systematic control gives us an opportunity to build a very big data collection for a lot of parameters incl. organoleptic, microbiological and chemical data. In the year 1990, Food hygiene institute checked in total 20567 samples of different foodstuffs, environmental samples and water samples, in 1991 21534, and in 1992 20101 different samples to collect the epidemiological data systematically from 62 regions in Slovenia (Florjanc, 1993). It was impossible to process all the data daily in order to have a general view what was going on. The reports were created yearly.

At the beginning, the main purpose of the program was to collect data for state statistics. Later, the program, because of it's openness became very useful tool for controlling the routine professional work in the laboratory. Finally it became a real scientific research application.

In the first stage of the software the development content of EKOS 2000 was relational data base which was necessary for input and collecting output reports. The sequential and tree data structures were used. Relations were described as attributes over the data fields. Software environment was developed specifically for working with tree data structures. The data were organized into the independent groups among which default relations were defined. Time and space optimizations were incorporated regarding to expected data quantity.

Today the system is working on three levels.

The base, so called first level is simple routine laboratory work, controlling the basic process of collecting description data of the sample and data collecting, and sending these basic data collections to the network. On this level, the software and the network together enable input of logically same or different data on various locations. Data content is primary data and data got from analyses as absolute values. On-line

modifications, improvements and searching can be performed on primary data base offering us faster and easier work. Colorful logical controls are implemented in the system intercepting possible input mistakes. Basic menu is used for input of all data types, which are written in different files. This type of input is the fastest way of searching and selection.

The upgrade, so called second level is filtration, fast searching (query) and counting selected data. On the same grade, reports are created, usually for inspection services and their own control of the number and suitability of the samples. Because of the relational construction, the data filters can be very complex. Reports can be organized and printed out in matrix and tree form.

The advanced mode, so called third level is important as scientific and research application. In the software environment the user interface is incorporated which makes possible in a very simple way to observe all data fields in free structural connections. According to the statistical theory and distribution of the results, simulations can be done and models can be created. Risk factors, risk analyses and quality evaluations can be calculated. EKOS 2000 is an expert system - software engineers created a shape and the epidemiologists filled content - the content was a condition for the form.

Materials and methods

Creating the shape of EKOS 2000 Software studio AZ used it's own programming tool, user interface was built up and appointed following users needs. The program was written in Borland Pascal language version 7.0, object oriented (Borland Int., 1992). At critical points, the time optimization was performed and written in Borland Turbo Assembler language for PC's (Borland Int., 1992). The most important characteristic is sequential files mutually connected with disk pointers. These pointers allow introduction of data fields which are set typed. These sets can be locally connected.

The basic purpose of the software is its use in food epidemiology and food control. This is the reason for its typical content. The sets are the origin and the source of the sample or material, set of samples (Jay, 1986), set of analyses (Mossel, 1977), set of standards, set of decisions, set of methods, and some others not so important such as for example addresses and postcodes. Selected and mutually connected elements from specific sets give us final report with connected results. These reports are basic elements of relational data base. Seemingly boundless data base is completely useless without the filtration. Conditions on data fields of the filter are optional and represent a full set of possible logical operators. Logical objects are used for the filtration using attributes of data fields. The poliphase sort method (Wirth, 1987) is used for sorting filtrated data.

Free matrix summarizing is implemented in PC's memory. Matrix element is vector of <n, sum(x), sum(y), sum(x*x), sum(y*y), sum(x*y)> (Snedecor, Cohren, 1967). The scale is tree structured similar as content of data base.

Free structural summarizing is a new developed tool which can not be found in the world wide commonly used databases. The principle of the method for this tool is selection of the attributed data fields, value comparing, checking and grouping in tree structural summary.

Zmodem protocol (TP Soft, 1991) connection between local area networks with data packing is used for state network.

Filling the program with the typical sets was running parallel with its implementation into the practice. Simultaneously, the process of data input, work schedule and organization scheme were adapted in order to be as simple as possible. The test and upgrade of EKOS 2000 were performed in cooperation with the institutions in Slovenia working in the area of food epidemiology and food control, as well as in research institutes. At the moment, the test is used on 10 local area networks and particular collections content over the 150.000 information (Florjanc, 1993)

Results and discussion

The result of three year work on the development of EKOS 2000 is a working application which supports all the needs of users on all three levels. Thus, it supports on the first level simple operations and overviews such as protocol book, date and time of inscription, protocol number of the sample, data of owner, producer or sender, analyses to be done and their results, date and time of report, decision report and so on. This level is specifically prepared for unqualified stuff in epidemiology and it supports completely independent input of parameters under the supervise. The second level is combination of searching and selection of filtrated parameters which are later counted and evaluated (number of specified samples, number of specified analyses, number of positive and negative results, number of samples or analyses per producer or other persons

dependent of the time interval). On this level, we can also create prespecified tables and graphs, and transfer the specified data collection into another programs (such as QuattroPro, Excel or SPSS) for further use. Advanced level of EKOS 2000 is in fact a collection of worldwide accepted statistical method and probability tests which can be used for simulation performance, e.g. for specified regions, expectations and also so called "future" simulations, statistically evaluated on the base of finished analyses. This can be carried out by the part of the program named Free structural summarizing of the data base. The good concept of systematic control combined with the inspection and the results of analyses can answer simply on a lot of complicated questions, and give advices how to solve current problems in trade, production and also in environment. Questions about correlation, regression, or chaos can be answered. It seems that an unique and simple data got from one analysis can't show us its importance. Nevertheless, connected in a chain, its importance can be decoded and evaluated. Finally, a possibility of making these chains is the most important result of the development of the system EKOS 2000.

Introduction of computerization on the field of food hygiene and food supervision becomes unavoidable. The complex system of solutions provides a very simple access to information, surprising clearness of complex data, possibility of trends analyses and deeper analyses of data formations.

Follow the complete process "from stable to table" and getting a global overview of the food producing system is possible only with the support of the computerization. It is impossible to process a few thousands of data following their time order and importance at the same time, and looking for sources and reasons of problems manually. At the time of data input we cannot be sure which data will be needed or used in the future. For this reason it is necessary to fill the data base with all known and logically related information avoiding possibility to loose something important. The quantity of the information in the process is practically unlimited.

Following the needs of the customers fast analyses of the data and searching procedures can be placed and performed to meet the needs of the state for statistical reports, those of the scientists regarding the data to refer, and many other similar needs.

Only the counting of results without deeper analysis of their mutual dependency is a waste of time and money. Deeper analysis is the base for the system used in our country. "Higher risk - sharper control, lower risk - less costs". Without having this kind of On-line information the programming of systematic control has no specific high value. Many times, unimportant problems can be exposed because of linear nature of control and later we see that it has its source on other location or, what is worse, it's not a problem at all.

Conclusions

1. Deeper analyses can be performed in very short time intervals only with the computer.
2. Reaction time of the system should be as short as possible.
3. Performing systematic control should be supported with very sophisticated data base.
4. Analysis of mutual dependency of information offers us a global overview.
5. Connection of the local networks into central network offers us a possibility to collect the data from other phases of food production.

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