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Organizing automated Ted dialogue on the competitiveness of science-intensive products

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Abstract. Organizing automated dialogue on the competitiveness of science-intensive products is based on the competence level of teams of independent experts.

Introduction

Staffing the group of independent experts is a special problem when organizing the procedure of science-intensive products automated monitoring. Here we should answer four basic questions:

1. Where should the experts be found: in the research organization or outside?
2. What is the optimal number of experts for the given type of research?
3. Which professional and psychological qualities should the expert possess?
4. How can the competence of expert for the given problem be estimated?

Organizing automated dialogue

The answers to the first and to the second questions depend, first of all, upon the goal of the research, as well as upon the characteristics of the objects under study, the supposed scope of research (number of alternatives and assessment criterions), the required accuracy and reliability of results, time and financial restrictions.

If the expert assessment requires profound knowledge of the company and its production specifics, it is more advantageous to employ the company's experts. If the assessment depends not so much upon the knowledge of the given company as upon the knowledge of the given market specifics, competing compatibles realized at this market, technological and socio-economical factors associated to the studied science-intensive production or technology, it is recommended to call the best specialists which mainly are not the employees of the given company. In the final expert survey it is reasonable to employ the experts of the company with minimum calling outside specialists which allows not only resource economizing but also holding the background information and the obtained results in confidence.

Possible lack of general professional expertise and globality of thought the company's experts compensate by the profound knowledge of their company specifics and interests, advantages and drawbacks of the output product, possibility of regular delivery considerable amounts of special useful information to the research director.

Improving accuracy and reliability of the research results require expansion in the number of experts. Most cases require 10-15 specialists, in some special situations it is possible to call up to 40 experts. Further increase in the number of experts, as a rule, leads to considerable growth of financial and time expenditures without significant improvement of accuracy and reliability of results.

The question of the required professional and psychological competencies possessed by the expert is answered according to the complexity and specifics of the studied problem, ways of further application of the obtained results. Most cases require average competency level, enough for understanding the problem to solve and computer supported work, as well as non-conformity and ability for constructive interaction with other participants of the dialogue. When the research is completed for educational purposes (higher school students' laboratory and course works) and in

other cases when the results do not have direct influence with production, the requirements for the specialist expertise lower. The benefit of the given variant is increasing the probability of taking a larger amount of factors into consideration resulting from the many-sidedness of knowledge of the expert group members.

The problem of competency level is solved by evaluating the latter by the director, by other experts and by self-assessment on a ten-point scale with further calculating the additive competence index by the weighted average method.

In general, significant efforts spent on forming the group are fully returned by optimization of result accuracy and reliability degree together with minimization of time and finance expenditures.

Developing efficient dialogue procedure according to the chosen criteria and data should be based upon the assessment of how the information exchanged by the experts influences accuracy of results. Here we can distinguish procedures which involve personal contacts between the participants and multi-tour procedures without personal contacts with the controlled feedback.

Each procedure can be realized in automated monitoring of science-intensive products, although, due to a number of reasons, the second type is usually preferred, Delphi technique being the most well-known. The given technique has a lot of modifications determined by the certain area of technique application or associated to the basics of expert team work organization [1-5].

Analysis of the ways of feedback organizing, kinds of information transmitted, principles of procedures shutdown, consideration of advantages and drawbacks of Delphi technique modifications allowed developing dialogue procedure satisfying the tasks of automated monitoring of science-intensive products. According to the developed procedure every tour of the survey supposes completing certain operations by the participants. However, before the first tour a package of preparatory measures is completed: selection of experts and familiarizing the experts with the research technique, developing spreadsheets for the full entity of criteria and alternatives, testing the readiness of the technical aids and the software of automated monitoring of science-intensive products.

The first tour of the survey supposes that the experts fill in the spreadsheets with unlimited number of entries and columns. It allows expanding the number of previously set criteria and evaluated objects. Thus, the first tour spreadsheet does not restrict the experts as far as the scope of problem investigation is concerned and reduces the possibility of not taking into consideration important factors not included into the base version of the spreadsheet. After all experts suggest their variants of spreadsheets the research director decides upon the final version to be used at the next stages. The director is guided by restrictions listed in the automated monitoring of science-intensive products instruction. The basic principle is including the data mentioned by the majority of experts into the final spreadsheet and excluding rare secondary elements. In this case the spreadsheet structure remains the same but limited horizontally and vertically.

In the second tour of the survey the spreadsheet developed in the first tour is used. The expert uses the interactive mode of the software environment which significantly facilitates spreadsheet completion, allows quick access to the automated monitoring of science-intensive products instructions in case of a mistake, avoids performing incorrect commands, provides access to the data base. After the experts finish completing the spreadsheets they are automatically processed and the report is produced with the possibility of print output.

Before the third tour of the survey the director familiarizes the experts with the results of the second tour. Basing on the given information the experts complete the spreadsheets again. The director does not set any special problems for the experts whose opinions differ significantly from that of the others. The automatic data processing algorithm is the same as in the second tour.

Before the fourth tour of the survey the director compares the results of the previous two ones and, if necessary, suggests that the experts change their assessments towards the average meaning. It is done for the purpose of increasing the opinion consistency. After getting familiarized with the results of the previous two tours and the director's recommendations the experts complete the spreadsheets.

In particular cases, with high opinion consistency, the survey is completed in three tours, with low consistency it can be extended up to five tours.

The basic restrictions of the procedure are determined by the Delphi technique specifics including:

1. The necessity of explaining the essence of Delphi technique and peculiarities of its PC-based realization.
2. The structure of the spreadsheets and the automated survey procedure do not allow wide opportunities for the experts to record non formalized text information for the research director.
3. There is psychological perception limit of the spreadsheets completed by the experts. Their size will depend upon the form of response to the question. In the simple spreadsheets requiring only "yes-no" answers, the number of table cells is practically unlimited. In more complicated spreadsheets where one has to fill in the criteria value assessments, it is recommended for the number of table cells not to exceed 100.

Thus, in the developed procedure for the automated monitoring of science-intensive products the experts are completely isolated from each other and at every tour receive feedback information from the professional manager on the average quantitative assessment of the new product and width of the confidence interval and, thereupon, retain or change their assessment. Iterating finishes if, according to the manager, researcher, enough opinion consistency is achieved.

The main advantage of the given procedure over the procedures involving personal contact between the experts is reducing conformity, pressure of "majority opinion" on the experts which is characteristic for panel discussion. Beside general benefits of Delphi technique, the dialogue procedure of the automated monitoring of science-intensive products developed and suggested to estimate the compatibility of product specimen has the following advantages:

1. The procedure provides the opportunity of completing the expert survey in a number of tours including expert survey timesharing within one tour.
2. Identical algorithms and calculating procedures applied in all tours allow using the results of the previous and any other tour as initial information for the current tour.
3. The manager may regulate the mutual influence degree over a wide range according to the goals of research. This may be achieved, among other factors, by changing the amount of qualitative and quantitative information given to the experts.
4. Time expenditures for thinking the answer over and completing the spreadsheets are minimized due to the utter simplicity of the questions posed to the experts and wide opportunities of the software environment being used.
5. The expert competence and opinion consistency levels are taken into account when assessing the compatibility criteria.
6. The procedure provides the opportunity of wide application of statistical analysis of experimental results.

So, the compatibility research is completed as a result of reiterated interaction between the expert and the PC when the expert completes the spreadsheets, answers the questions, feeds the answers into the computer, receives the indicator values and recommended solutions, changes his or her assessments, feeds them into the PC again, etc.

The basic procedure of alternatives assessment is carried out according to the method of calculation of the developed additive-multiplying indicators [6]. Meanwhile, the leveled numerical values of verbal characteristics are already used in the assessment sheets. The expert may both use the recommended leveled values and establish his/her values within the given range. Expert alternative assessments are processed automatically in order to find out if they belong to compatibility and final ranging areas.

Conclusion

This way, the developed technique is a real and efficient means of achieving target goals within the automated monitoring of science-intensive products, making it possible to take the advantages of group survey methods, at the same time, minimizing most drawbacks brought about by experts mutual influence. In spite of increased time expenditures for survey preparation and completion,

time expenditures for data processing are significantly reduced, while the accuracy and reliability increase. The developed and studied Delphi technique modification based on the automated monitoring of science-intensive products allowed designing a more reasonable and efficient dialogue procedure.

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