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SIMULATION SOFTWARE SELECTION "WHYS AND HOWS"

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Dedicated to the memory of Professor Jovan Petrić, a pioneering and eminent Operations Researcher

Abstract: Selection of appropriate simulation software is of considerable importance to any simulation practitioner. As simulation packages grow in quantity and quality, their complexity and the variety of application areas make it more and more difficult to choose one. The need for a methodological approach to this problem using appropriate tools and evaluation techniques is apparent. This paper investigates why the selection of simulation software is important and goes through a selection process step by step, discussing the techniques and tools used for selection. The method is intended to result in an updatable database containing the criteria concerning simulation packages to be used in a selection process for various application areas.

Keywords: Simulation software, software evaluation, software selection.

1. INTRODUCTION

The availability of computers, specially after the introduction of personal computers two decades ago, has been an important factor in the development and use of software. Selection of the appropriate software is of considerable importance to users. In fact, being dependent on the wrong tool is worse than being dependent on no tool. It is similar to having the wrong data, which is worse than having no data.

Similarly, to any simulation practitioner, the selection of an appropriate simulation package is a vital issue. As packages grow in quality and quantity, the complexity makes it more and more difficult for the selector to make a decision on choosing the most appropriate one. Obviously in such a situation, manual selection will

take time, cost a lot of money, and may not give a good solution. Therefore a structured approach for simulation software selection is proposed, and the role of software as a tool to help in this matter is investigated.

2. WHYS: THE NEED FOR SIMULATION SOFTWARE SELECTION

It may be possible to do a job without knowing why we are doing it. But knowing the reasons for doing a job can have a positive effect on the work. The variety of simulation software, the growing number and quality, the high cost of packages, the vast area of applications, the complexity of the models, and the reasons mentioned in the introduction justifies the requirement for a careful selection of simulation software which best serves our needs. The following explains the basic reasons for simulation software selection.

2.1. Vast area of application

Simulation has become a popular methodology with a broad range of applications. Doukidis and Paul [3] surveyed the frequency of use of more than ten modelling areas and simulation came third. Considering the question of what kinds of systems can be simulated, the answer is that any system can be modelled [13, 16, 17]. The variety of the application areas and the fact that some packages may be more suitable than the others for a specific application area is an important reason for selection.

The wide area of application of simulation has caused software engineers to make more of a contribution to this field. As a result the number of software packages for simulation has increased and more and more people have become involved in the development and application of simulation software.

2.2. Growing number of simulation packages

Ever since simulation became a popular tool to help managers to make decisions, it has been computer based. This may be one of the reasons why the number and quality of simulation software have been growing so fast. Obviously the matter of selection appears wherever there is a choice. The more choices we have the more difficult may be the selection. The following are names of some simulation software on the market: ARENA, AutoMod II, Comnet, Extend, GPSS +, GPSS/H & Proof, INSIGHT, Instrata, Micro Saint, Modsim II, ProModel (DOS), ProModel (Windows), Sigma, Sim++, Siman/Cinema, SimFactory, Simpack, Simple++, SIMPROCESS, Simscript II.5, Simul8, SLAM II, SLAMSYSTEM, SLX, Smalltalk, Taylor II, VS7, WITNESS, XCELL +, YANSL. For such a list, how would the relatively uninitiated start choosing?

2.3. Costs

The cost including the price of the package, the set up cost and the running cost is another important issue. Gogg and Mott [4] consider the cost and benefits justification as a major factor. "The purchase of a simulation package is usually contingent upon a justification process. The profits anticipated must be greater than the cost of obtaining them" [4]. It is necessary to mention that because of the complexity of the simulation packages and the necessity for an expert to do the selection, selection is costly, too. Therefore the selection method should somehow make selection less costly.

2.4. Complexity, capabilities and features of packages

All software developed to be used for the same purpose should act similarly for some main basic aspects. What makes the difference is the way they do it, how they do it, and what other capabilities they have. There are many elements (criteria) which affects the evaluation and selection of simulation software. The subject has become so important that it has been the main or an important part of research by many researchers. Experts usually give a list of the most important criteria of simulation software according to their experiences and findings [8, 10, 12, 14, 16]. These and other expert comments give an indication of necessity for selection and the important factors which affect it (but for good selection, we really need a detailed classification of simulation software criteria).

2.5. Type of application and complexity of models

"It is impossible to produce an all purpose simulation modelling system that can handle any problem one might wish to model" [13]. Simulation software is not independent of the type of application and the needs of the user. A package may be best for some applications but not for others. What we should look for is the most appropriate package rather than the best one. In fact, there is no best package. Pidd [14] mentions the type of application as one of the criteria for choosing simulation software.

Gogg and Mott [4] said: "The selection of a simulation package should be based on the specific needs of a user. Finding a package that will ultimately satisfy your requirements is best accomplished by experimenting with multiple packages to investigate their individual qualifications as compared to your needs".

3. HOWS: METHODS FOR SIMULATION SOFTWARE SELECTION

Different methods could be used to select simulation software. Experts have approached the problem manually (for a substantial reference see [7]). Manually, we consider the needs, then look at the available packages one by one and select the one which we think satisfies our needs best. We may employ some techniques to choose the

best of several [2]. The manual method is costly and not economical and may not end up with an optimum selection. It does not have the flexibility to respond to changes in needs. Most important of all is the fact that manual selection is good only for the situation it is applied for and we have to do it again for a new application. The need for a methodological approach for simulation software selection and the use of appropriate tools is apparent. A literature search on previous work shows that little effort has been put into establishing a structured methodology for this task [7, 9]. In the coming sections we suggest a structured method and explain it step by step. A diagram of the proposed method is shown in figure 2.

3.1. A deep and detailed knowledge of the simulation software

This is the first step in the selection of simulation software. Irrespective of the method used for selection, a very good knowledge of the features and criteria of packages is necessary. The more we are aware of the details of packages in a pre-defined structure, the better we can know, test and evaluate them. The reasons outlined in section 2 indicate the basic general influential factors. All the information relating to the subject should be taken into account to the appropriate level of detail. As said above, experts have given a list of important criteria. Hlupic and Paul [8] gave more than 300 evaluation criteria within several groups of criteria.

3.2. Hierarchy of criteria

A package will be better understood if we use a pre-defined homogeneous hierarchical architecture (figure 1) to investigate the features and capabilities of that package. The hierarchy should consider the aspects of the packages made for a particular type of application. It must be suitable to test and evaluate the packages. For a new application we should not be made to change the hierarchy but be able to do the appropriate selection by giving different priorities to criteria. We will also use it for determining the needs in the selection process in later stages. Minor changes in the hierarchy will happen by introducing a new criterion. Major changes will cause a re-evaluation of the packages. The hierarchy should be tested and fixed by going into a few packages using an appropriate simulation model.

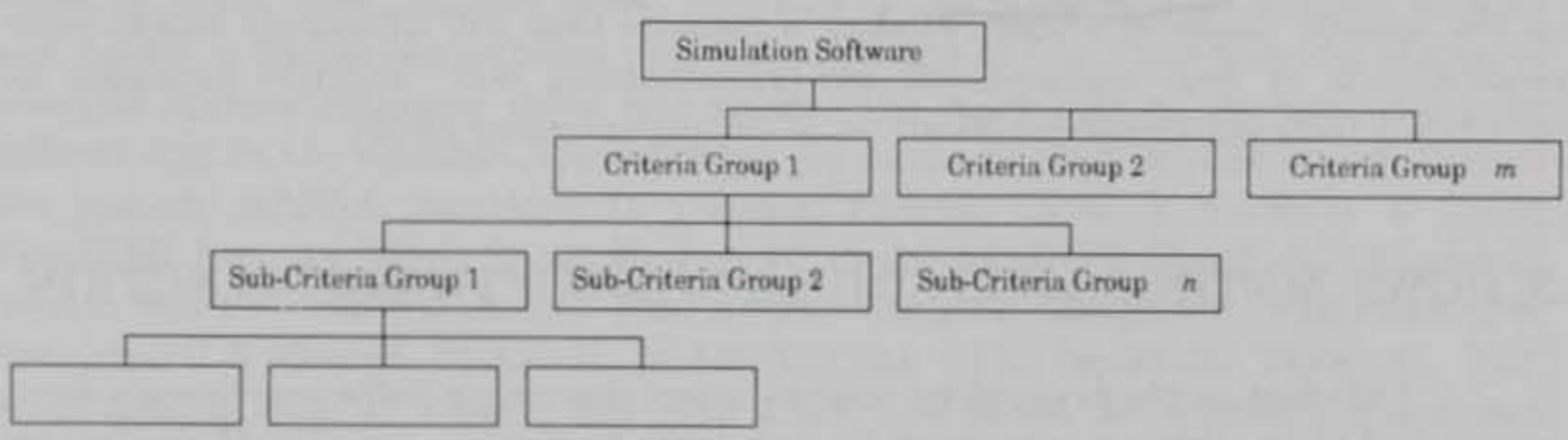

Figure 1: Hierarchy of the Simulation Software Criteria

3.3. Testing the packages

Using the proposed hierarchy of criteria we will go into the packages to discover their features and capabilities in as much detail as possible. For any feature in the hierarchy we will investigate the packages to find out if they have it or not. The data gathered from this stage will be the basis for evaluation of the packages.

3.4. Evaluation of the packages

Most simulation software criteria are non-numerical and there is no standard method for quantifying them easily. On the other hand a checklist of simulation software indicating what features a package has, does not show how good it is. This only shows which ones have the required features and which ones do not. Banks [1] deals with "the difficulty involved in interpreting a checklist when selecting simulation software". He infers that "however, these indications are often inadequate to explain the full range of availability". One suitable technique for such a situation is scaling by comparison [11, 15, 18].

Since selection of a simulation package is not independent of the application area, therefore a single number indicating the overall value of the package will not give an indication of which package to choose, unless the packages are evaluated for that specific area of application. To avoid repeating evaluations for different areas of applications, we evaluate the criteria groups rather than the packages as a whole. In other words, scaling should not be among the packages, rather among the criteria groups. As we said earlier, it is in the selection stage that we decide which package to choose by weighting the criteria groups.

3.5. Database of the evaluated packages

Evaluation of a package is costly, needs expertize and takes time. Therefore it is beneficial to keep the resulting information in a database to be able to use it for later selections incurring less cost. In this database, each record represents a package and each field of a record represents the relative value of a criteria group with respect to other packages in that criteria group. If we show the values of our packages in an n-dimensional space, where n is the number of criteria groups, our database is in a space with relative dimensions because each value is relative to others and not independent of them. Mapping the database to a space with absolute value dimensions makes it much more suitable and easier to update the database, using a suitable method, and do the selection. In fact, the first time the database is made, it contains the relative values. After these values are changed into absolute values, the new packages and the update of the existent packages will automatically get the absolute value.

The above stages are general and we do not change them for different application areas. The next two steps, particularly the first one, are application based.

3.6. Determining the needs and priorities

Some of the needs for any application area are common. But there are some needs which differ among application areas. There are even some differences between two similar application areas. The package should be selected according to needs. The needs should be specified based on the criteria groups. What really makes the difference here, is the priority given to each criteria group. The same scaling by a comparison method used for evaluation of the packages will be used here to determine the priorities. A trade off among the needs are possible. The user may set some critical points where, below that point, the selection will not be acceptable.

3.7. Selection

As mentioned earlier, the manual method of selection is time taking, costly and non-optimal. A methodology for the selection procedure should make use of the appropriate tools. From what we have said up to now it is clear that we should use software as a tool to look into the database, choose acceptable software according to the critical points, and select the best software taking priorities into account. Obviously the proposed tool is expected to help in other stages, such as determining the needs, setting priorities and critical points, and updating the database. The software tool will give flexibility and a much higher speed to the system. SimSelect [5] has taken the first steps in this direction. In summary, our proposed method described above, is shown in concise form in figure 2.

4. BENEFITS OF THE PROPOSED METHOD

Looking at a simulation package using a well-structured hierarchy of criteria would make it possible to have a better knowledge of the package and be able to test it precisely. Another benefit of the proposed method comes from the fact that many of the simulation software criteria are non-numerical and there is no standard technique for quantifying them, therefore scaling by comparison method gives a good result for evaluation.

The benefits of a database are better search, quicker update and future use. It may be said that because of the quick upgrade of the current packages and marketing of new ones, the database becomes out of date very soon. However it is much more beneficial to update an existent database rather than evaluate the packages from scratch. The critical points and the priorities will give a flexible selection. It makes it possible to use the same database for different application areas by changing the priority weights. The database can be used to find out the characteristics of a popular simulation package which helps the vendors to improve the quality of their products [6]. It can also be used for direct quantification of criteria. Making use of software as a selection tool speeds up the process incurring less cost.

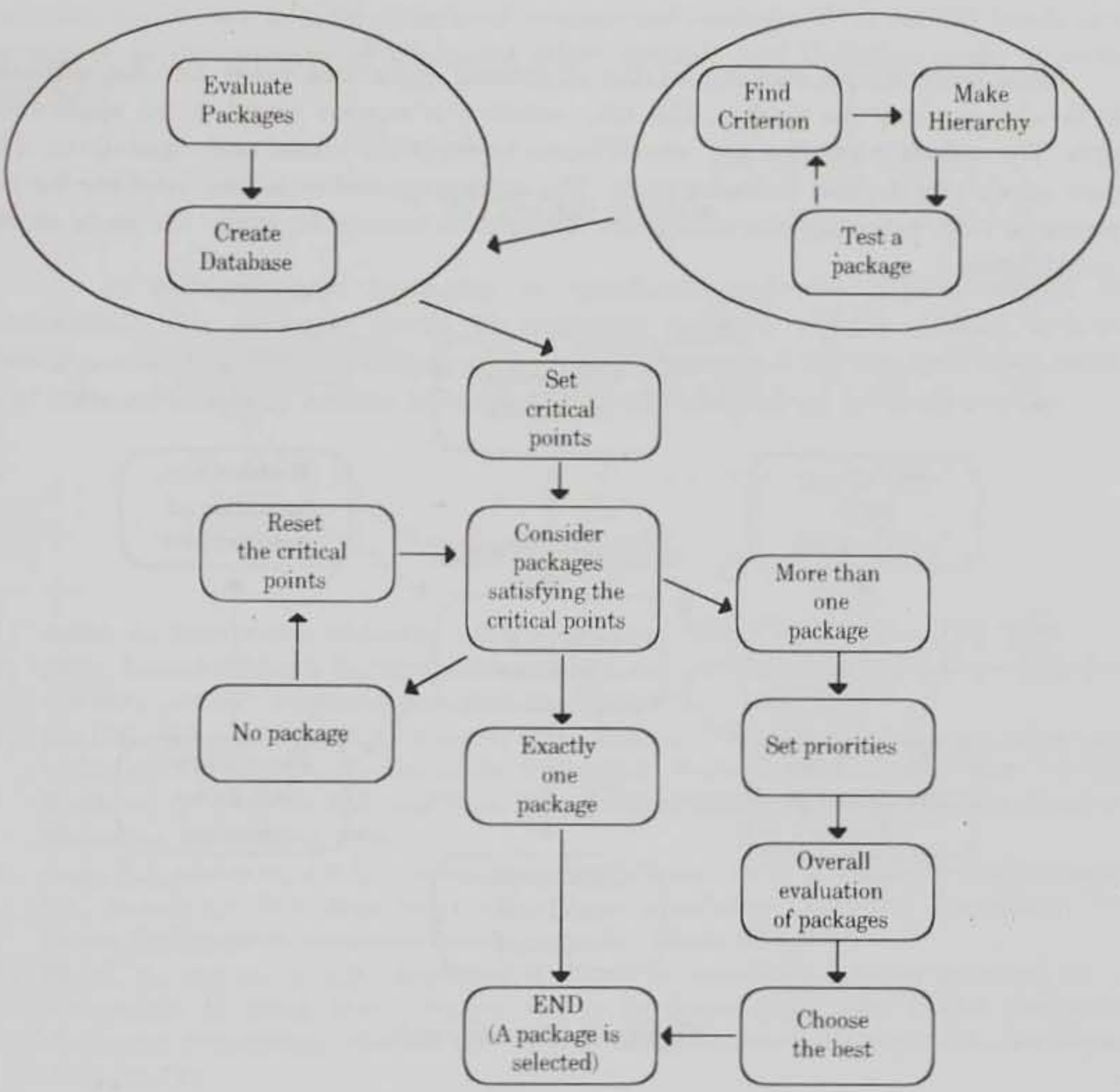

Figure 2: The proposed method

5. ALTERNATIVE METHODS

Two alternatives are suggested. The first one is not as confident as the proposed method and the second one is not easy to follow.

5.1. The Easy Way

Skip quantification of criteria in step 3.4. The database will contain a checklist which shows if a package has a feature or a criteria. In this case there is no need for priorities and critical points. The needs are determined by constraints that a feature is needed or not. Figure 3 shows the selection process in this case.

5.2. The Hard Way

Make some sample models covering all general application areas. Develop software to be able to show the models. The user selects the nearest model to his application area. The software lets the user see different levels of the model and capabilities. The user selects the desired characteristics. The software searches in the database for the packages with matching characteristics. The search process is nearly the same as the one in figure 3.

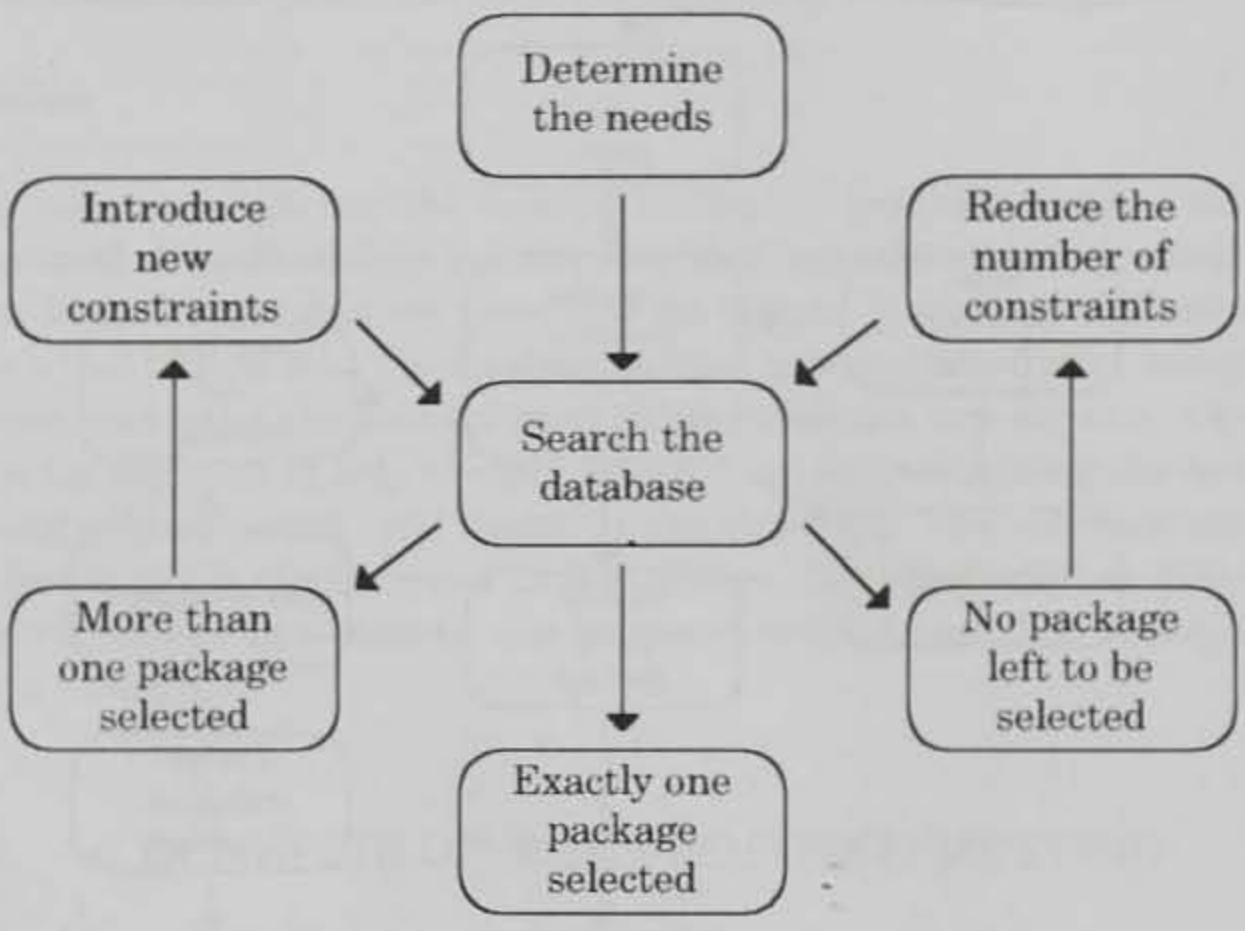

Figure 3: The easy way

6. SUMMARY AND CONCLUSIONS

Vast areas of application, complexity, growing numbers, high cost and expertise needed for evaluation, non-quantifiable features and the fact that evaluation of simulation packages is not independent of their application area show the necessity for the development of a confident and efficient method for this task.

A clear specification of the simulation software criteria set in a well-structured hierarchy will become the basis for evaluation of the packages. To avoid repeated costs the result of the evaluation of the simulation packages will be put in a database for later selection. According to the application area the needs and the priorities will be determined. Software will be used as a tool to help the decision maker at different stages.

By the proposed method, one could achieve a better, faster and more flexible selection based on a broader domain of criteria and packages. This should result in a reduction in the amount of time and effort needed, and therefore make it more beneficial.

7. FUTURE WORK

A well-structured hierarchy of simulation software criteria should be established. The packages should be evaluated using a suitable scaling method. Development of an efficient technique for proper updating of the database is essential. And software should be written to be used as a tool to help in the selection process.

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