

On the practical use of CASE-tools

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On the practical use of CASE-tools results of a survey

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Abstract

This paper describes the results of a recent survey among experienced CASE-tool users in the Netherlands. After a general description of the survey the main results are discussed. Subjects of the survey were a general evaluation of the tools used, a comparison of the objectives envisaged when acquiring the tools to the objectives that were seen to be attained, selection criteria, impact on the organisation and future use. The paper concludes with a series of conclusions regarding the benefit of CASE-tools and their likely future.

1: Introduction

In the spring of 1992 a questionnaire was sent out among Dutch CASE-tool users aimed at providing insight into the experiences that were obtained using these tools. In this paper the results of this survey are presented together with the main conclusions.

2: The project

Design and execution of the questionnaire has been carried out within the context of the PICO (Practical Inquiry to CASE in Organizations) -project. The project has been organised and financed by a consortium of independent organisations in order to assure an unconstrained enquiry into CASE-tools experiences. Cooperating parties were:

- NGGO (Nederlandse Gebruikersgroep van Gestructureerde Ontwikkelmethoden, the Dutch User Group of Structured Development Methodologies),
- SERC (Software Engineering Research Centre) and
- the CASE Research Lab of the Amsterdam Free University.

This survey can be regarded as a successor to the NGGO report "Experiences with tools" (Wijers en van

Dort, 1990) in which the results of a previous survey are presented. This survey restricts itself to the so-called 'upper CASE-tools'. 'Lower CASE'-tools have not been looked at, unless in the context of an I-CASE-tool.

The survey was carried out by means of a 16 page questionnaire containing 55 questions. Most of the questions were in multiple choice format although some open questions were added. The questionnaire was divided into eight sections, each covering a part of the life cycle of a CASE-tool:

- 1 introduction,
- 2 background information,
- 3 determining requirements,
- 5 selection,
- 6 introduction,
- 7 use,
- 8 evaluation,
- 9 future expectations,

3: Goals

On the one hand these user experiences have been gathered to support potential users. Both organisations still trying to select a tool and those that are considering a switch to another tool can benefit from the experiences that have been acquired by others. These experiences can be used to develop a CASE-tool strategy specific to the organisation. When drawing up this strategy apart from local information now also relevant information from comparable organisations can be used. If it is decided to adopt a tool the information from the survey can be used to judge and compare the different tools available in the market.

The results presented here furthermore provides a signal for the vendors providing information on the degree of satisfaction with present tools and on additional requirements aimed at a future generation tools. It also provides information on the segmentation of the (Dutch) market and on the relative position of their product in it.

4: Response

Due to the cooperation of a large number of CASE-tool vendors a list of Dutch CASE-tool users has been compiled. The questionnaire has been sent to 1886 CASE-tool users in 1128 different organisation. A response of 287 completed questionnaires was obtained hailing from 262 different organisations. This represents a response of 23.2% of the organisations. For a questionnaire of this type, taking into account the size of the questionnaire form (16 pages), this is a altogether satisfactory result. Completing the questionnaire proved for many respondents to be a time consuming activity.

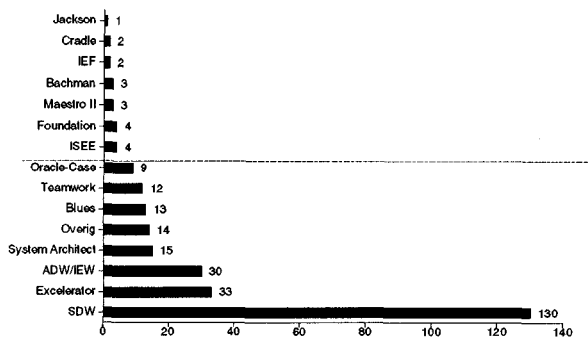


Figure 1: respons per CASE-tool

In figure 1 the division of questionnaires over the different brands of CASE-tool is presented. The tool SDW, originally a Dutch development which now is marketed in the whole of Europe, clearly has the highest response. This is no change from the situation in 1989. Excelerator still occupies the second place, although its relative share has declined. The IEW/ADW combination still takes third place. No large changes have occurred during the last three years. Also their total market share has remained the same (70%). Noticeable among the other tools are the (new) tools System-Architect and Oracle-Case with a relatively high response.

5: Experience

In figure 2 the number of years of experience of the respondents with their tool has been presented. Compared to the previous survey (Wijers en van Dort, 1990) the average experience has increased significantly. Then only 11% indicated to have used the tool for more than two years. In this survey this figure is 53%. Compared to the 57% who had been using the tool for less than one year in 1989 the 19% in this survey

represents a marked improvement. This survey can therefore assumed to be based on a sound body of experience.

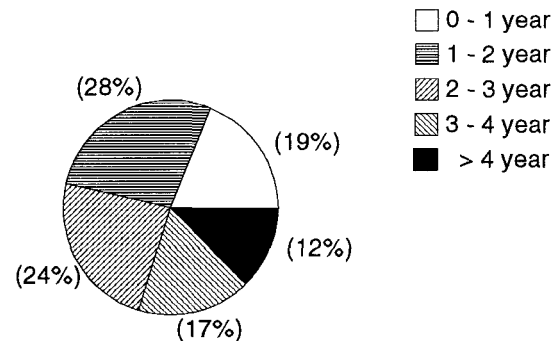


Figure 2: importance of CASE-tools

Table 1 shows that in slightly more than half of the organisations usage of the tools is prescribed. For developments methods this is percentage is somewhat higher. Generally speaking their use is either compulsory for both or for neither.

Another measure for the degree of automation of a software development department is the degree of penetration of CASE-tools: how many analysts and developers use the tool on a regular basis? These data are presented in figure 3. In 38% of the responding organisations the tools are used by a majority of analysts and developers.

On the basis of these data it may be assumed that the respondents know what they are talking about. They have an average experience of three years, and the tools are really used by them. Therefore we can confidently work on the assumption that the survey results represent a true picture of the use of CASE-tools in the Netherlands.

6: General evaluation

First we looked at the importance that was attached to CASE-tools. Generally speaking the respondents are positive. Only 16% of the responding organisations are of the opinion that CASE-tools are of limited significance. 22% considers the significance to be 'reasonable' and 47% thinks the importance is 'significant'. 15% even considers CASE-tools to be essential for systems development. We appear not to be discussing an insignificant subject.

Next the respondents were asked to give in one mark an over-all evaluation of the CASE-tool in use in their

		use of method standard	
		yes	no
use of tool standard	yes	134	10
	no	35	88

Table 1: standardisation of tools and methods

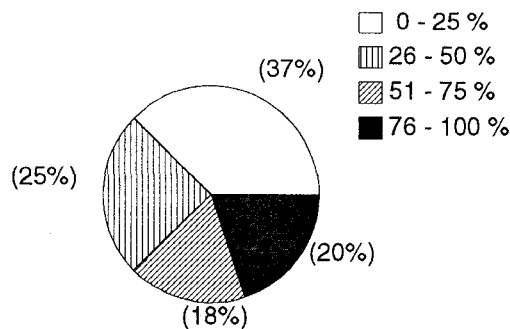


Figure 3: degree of use of tool

organisation. The results are presented in figure 4. From this it follows that the tools are generally speaking judged to perform in a satisfactory manner as is shown by the average rating of 7.03. If we look at the unweighed average of the results per tool (tool average) in order to remove a possible effect caused by a single tool, we see no significant difference (7.1). The ratings do not vary much over the different tools. Excelerator with an average of 6.3 scores a bit below average, while System Architect with 7.3 and SDW with 7.2 end up somewhat above average but these differences are hardly exiting. What is remarkable is that no tool is rated really high. None of them is received enthusiastically.

An interesting question is whether different types of organisations differ in their judgement with regard to the tools. We looked at two kinds of differences between organisations; organisations which differ on the manner

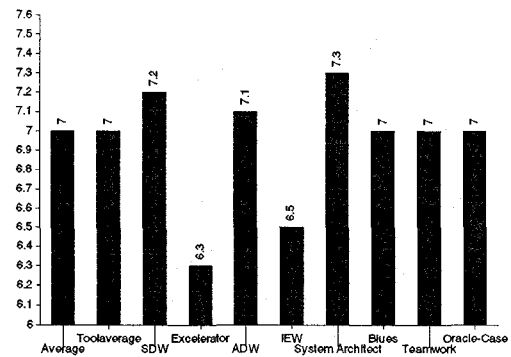


Figure 4: over-all evaluation

of use of CASE-tools and organisations which differ in the degree of process awareness.

Lets first define these notions. We make a distinction between organisations exhibiting a more advanced use of CASE-tools versus less advanced users. Advanced use is demonstrated by a more or less complete coverage of the systems development life cycle by tools. Of the responding organisations 30% fall into this category. These are the more advanced tool users. They could be said to have a more technological orientation.

Organisations are defined as having a medium process awareness if they carry out project, configuration and quality management as well as software cost estimation. If in addition to this also process measures are maintained, statistics on errors in design and code are collected and procedures for introducing new technologies exist, the organisation is said to have a high process awareness. Among the responding organisations 55.7% show low awareness, 36.1% achieve a medium process awareness and only 8.2% exhibits a high process awareness. This categorisation of responding organisations according to their level of process awareness or planning maturity is loosely based on Humphrey (1989). These organisations can be said to have a more organisational orientation.

If we now look at the evaluation of the tools by type of respondent we notice that as we would expect advanced tool users value their tools slightly higher than others (7.22 versus 6.94). No real differences can be found between organisations with a different level of process awareness. However, this changes when the two factors are joined together (table 2).

In those organisations with a low process awareness no real differences can be noted, but this changes when we look at the respondents with higher level of

Level of process awareness	advanced user	
	yes	no
low	7.05	6.99
medium	7.29	6.95
high	7.75	6.41

Table 2: Evaluation of CASE-tools related to the type of organisation involved.

awareness. When the higher level of attention for planning is matched with a similar increase in attention for the technological side a marked increase in the rating for the CASE-tool can be observed. If on the other hand the attention for planning is not matched, a much lower rating is given. It is clear that technological and organisational concerns go hand in hand in this case.

Apart from this general rating a question was posed on the degree in which original expectations with regard to the tool have been fulfilled. These expectations were realistic is the opinion of 65% of respondents. 32% claims to be disappointed and only 3% found their expectations to be exceeded. This means that a substantial minority went into the adoption and implementation process with (too?) high an expectation which in the end led to disappointments. In order to take a closer look at possible causes for this disappointment the next section will look at the objectives that were (not) attained while using the tools.

7: Objectives realised

In this section the degree in which a number of objectives were realised will be discussed. The data are presented in figure 5. This figure is based on the following scale:

- [1 = not at all];
- [2 = somewhat];
- [3 = reasonable];
- [4 = good];
- [5 = very good].

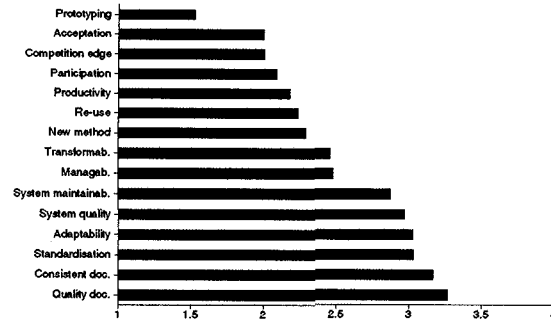


Figure 5: rating of tools on attainment of objectives

The objectives realised best are an improvement in documentation, followed by an improvement in the consistency of systems development products and the adaptability of intermediate products. These are all objectives that have a connection with documentation, either making it or adapting it. Apparently the tools are best used as a documentation aid. All the objectives score on average a little over three, that is a bit better than 'reasonable'. It is clear that for no single objective the tools are evaluated as 'good'.

The first objective aimed at the system to be developed itself is 'improving system quality'. This objective is valued on average as almost 'reasonable' followed closely by 'maintainability', the second objective aimed at the system itself. Both objectives are not attained conclusively. It is not that they are not attained at all, but at first glance there is certainly no reason for celebration.

It may be clear that the present generation of CASE-tools will not be able to solve all the industries problems in the areas of quality and maintenance. This does not necessarily sum up as a wholly negative result. Quality and maintenance belong to the most serious problems of the industry. Any approach that only partly contributes towards solving these problems should be more than welcome. The data indicate that CASE-tools can indeed provide such a contribution. If the partial aspect of this contribution should disappoint the expectations of those users gullible enough to believe all that is promised in advertising it only can mean that these expectations were unrealistic in the first place.

After these first six objectives a gap occurs. The other objectives are valued decidedly lower. The average rating drops fast to 2 ('somewhat'). Goals such

Objectives	Type of organisation			
	all	advanced users	high process awareness	both
doc. quality	1.7	2.1	2.1	2.9
doc. consistency	2.1	2.2	2.5	2.6
standardisation	2.0	2.3	2.6	2.5
adaptability	2.1	2.4	2.5	2.8
system quality	2.2	2.2	2.2	2.2
system maintainability	2.3	2.6	2.7	3.0
manageability	2.1	2.2	2.0	1.7
transformability	2.4	2.8	2.7	3.0
method	2.4	2.4	2.5	2.4
re-use	2.8	3.1	3.3	3.1
productivity	2.9	3.1	3.2	3.3
participation	3.1	3.3	3.2	3.4
competition edge	3.0	3.3	3.1	3.1
acceptation	3.1	2.3	3.2	3.2
prototyping	3.2	3.5	3.3	3.4

Table 3: Achievement of objectives by type of organisation.

as improving productivity and the re-use associated with it end up at respectively a tenth and an eleventh place. All goals related to the position of the end-user (participation, acceptance and prototyping) end up even lower. Apparently no real advantages can be gained on these points.

Summarised we see that the main advantages of CASE-tools can be found in the areas of documentation and a more flexible systems development process. System quality and maintainability are also enhanced. Productivity gains, once reputed to be the main benefit of CASE-tools, are hardly mentioned at all. This can hardly be considered to be a strong point of the tools.

Again, as with the over-all evaluation, it is interesting to look at those organisations which make a more advanced use of tools and those that exhibit a high process awareness. The results are similar (table 3).

Organisations that make a more advanced use of their tools attain a higher rating at nearly all objectives. This is also true for those organisations that exhibit a high process awareness. And finally those organisations that are trying to develop in both technologically and organisationally tend to score even higher yet. The conclusion, drawn in the previous section, that a combined focus at both technical and organisational aspect provides the best results is substantiated by these results.

8: Selection criteria

Also part of the questionnaire were the criteria that play an important role in the CASE-tool selection process. The following five criteria were found to be the most important ones:

1. the degree of coverage of the techniques in use,
2. the quality of the man machine interface (userfriendliness),
3. the degree of integration between the techniques used,
4. vendor continuity,
5. the expected growth potential of a tool.

The first criteria are aimed at the direct potential for use of the tools. Support for all techniques in use, integration between them and userfriendliness together provide sufficient potential for the tool to be useful immediately.

The other two criteria look at the vendor. They are not aimed at the tool as-is, but at its future possibilities. Regarding this future the average tool user concentrates mainly at his own vendor. The alternative is to rely on the development of a series of open standards, but all criteria related to this issue are valued low, therefore disqualifying this alternative.

More than the objectives these selection criteria seem to imply that CASE-tools still have a long way to go. Most users seem to set their aims at a longer term for

realising the potential of CASE-tools. We infer this from the high importance attached to the criteria 'vendor continuity' and 'growth potential' even before the criterion 'output' which is essential is achieving the most highly rated objective, namely 'improving documentation quality'.

An interesting additional point is the comparison between the rating of these criteria on the basis of user experience and the importance attached to them by these same users. This gives an indication as to the shortcomings of the present generation tools and the changes required of them. The results are represented in figure 6. It is obvious at first glance that the rating of nearly all criteria is significantly lower than that which is desired.

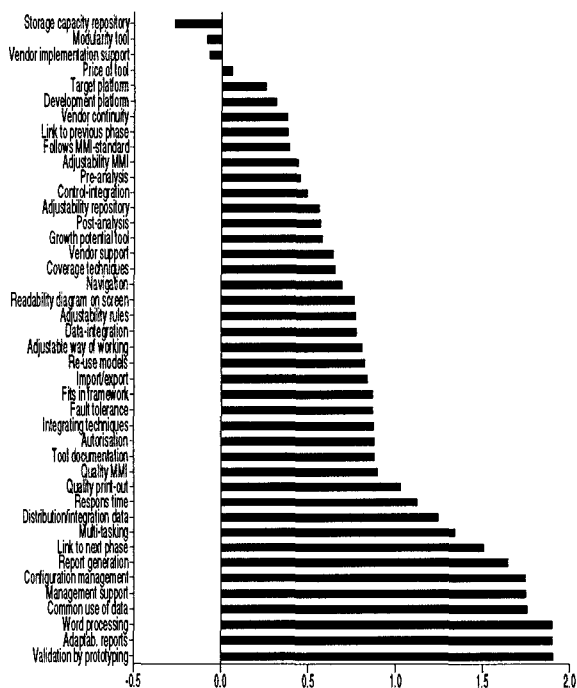


figure 6: differences between rating and importance of criteria

On eight criteria the differences exceed 1.5. Three of these have to do with the output facilities of the tools (adjustability of reports, the standard supply of reports and the word processing facilities). Apparently more

flexibility in this field is required. A tool that is mainly valued for its documentation facilities should perform well here.

Prototyping and simulation facilities are also valued lower than should be expected by looking at the importance attached to them. Other weak points can be found in the area of data exchange: common use of data and data exchange between phases. Finally project-management and configuration management facilities leave much to be desired. On the whole this is not a very good performance of the tools involved. It seems there is sufficient room for improvements.

9: Effects on the organisation

Apart from looking at the tools themselves, it is also interesting to look at the effect these tools have had on the way systems development is carried out. It appears that users of CASE-tools notice little or no such organisational effects. The only consequence a majority of the respondents (53.3%) agree on, is an increase in standardisation of tasks, the achievement of which is seen to be assisted. A substantial minority (40.2%) is of the opinion that planning and controlling software development is facilitated. Also quite often (40.6%) a shift from programming towards analysis/design is noticed. The occurrence of such a shift is one of the benefits that have traditionally been claimed for CASE-tools. These data in this survey seem to support this claim.

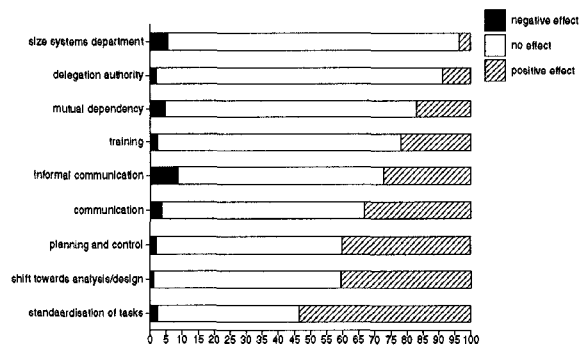


Figure 7: overview of organisational effects

Another possible area where effects can occur is in the communication between systems engineer and future systems user. Opinions as to the occurrence of this effect are evenly divided. A little over half of the respondents (52.1%) claim that changes did take place, the others (47.9%) disagree.

In answer to the question what these changes consisted of, 71.9% indicated that the systems documentation was more understandable for the end-users. Involving the end-user by means of prototyping comes in at a second place (26.7%). In some cases end-users even start designing themselves ($\pm 1\%$).

Finally it was asked what the judgement of end-users

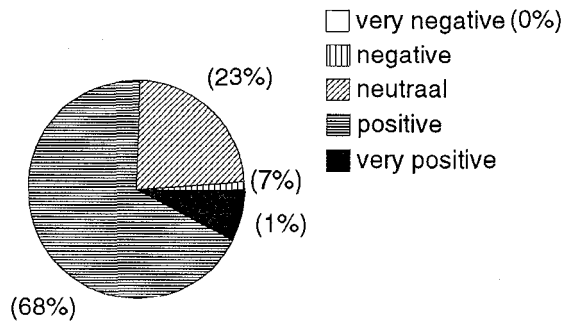


Figure 8: rating of communication

with regard to these changes was. The answers to this question have to be treated with caution since it was not put to the end-users directly but to the tool-users.

As could be expected, answers vary from negative (2%) to positive (figure 8). Very negative experiences are not reported. On the other extreme some very positive experiences have been found (8%). On the main the development is judged to be positive. On average this question was rated 3.79 on a scale of 5.

The conclusion may be drawn that some organisational effects can be shown to exist, but that the total impact of the use of CASE-tools on the organisation of software development is not very large. This comes as no surprise. It takes more than just the introduction of a new technical aid, no matter how sophisticated, to change the way an organisation functions. At this moment CASE-tools are used to support the existing methods of software development. Introduction of the tools rarely coincides with a re-evaluation of the systems development process. All data in the survey tend to confirm this picture.

An unexpected side-effect of the introduction of CASE-tools is the changes it brought about in the relationship with the end-user, for instance via the use of prototyping. It is unexpected because these issues were rated very low on the list of goals achieved.

10: Future importance

The field of CASE-tools is changing rapidly. Given the average experience of the users with the tools it can be stated that we are still dealing with a young emerging technology. An interesting point then is whether the technology will continue to emerge or whether it will founder. To answer this point a question was included in the questionnaire asking if the position of CASE-tools in their organisation will increase in importance in the future, if it will remain the same or if it will decrease.

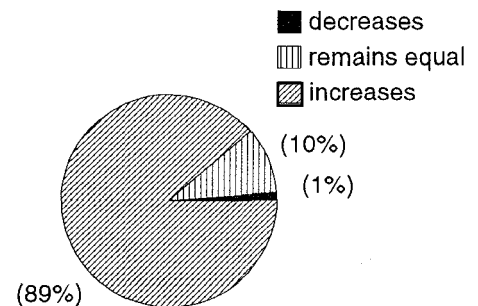


Figure 9: future importance of CASE-tools

The results are set down in figure 9. It can be seen that hardly anyone is of the opinion that the importance of the tools will lessen. At least the present level of activity will be maintained but most respondents are of the opinion that the future of CASE-tools within their own organisation will show an increase in status. This is a confirmation of the data presented up till now. Apparently the tools perform well enough to insure that people continue using them.

Since apparently the technology will not be smothered at birth it is reasonable to assume that the further growth of usage will follow a pattern similar to that of the introduction of other technologies which in general is some type of S-curve.

It is also possible to look at the future use of other types of tools. These data are presented in figure 10. Five GL environments and process management tools are the great unknowns in this company. An interesting result is the marked decrease in the expected usage of third generation tools. Less than 50% indicated their intention to use these tools at an equal or higher level. This is an indication that the end of the third generation, which has been confidently predicted ever since the appearance of fourth generation environments, finally comes into view. A large part of the

organisations will continue to use these tools, but their supremacy is gone.

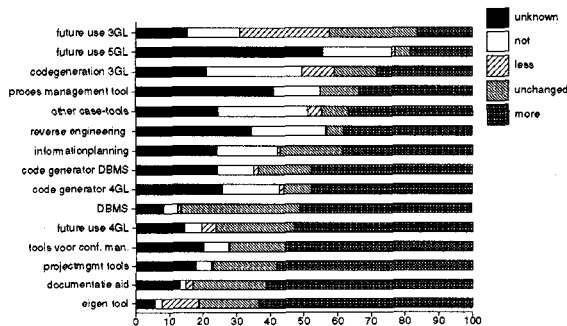


Figure 10: future use of other types of tool

If we look at the tools that score highest on the combination of equal and increasing usage, we see that the DBMS comes in first, closely followed by documentation aids. The tool for which the questionnaire was completed comes third. Given the strength of the competition this is a very high position. This position is even higher if also the other analysis/design tools are added. Only 13 respondents indicate that they will use this type of tool less or not at all in the future. On the following three places we find project management tools, fourth generation languages and tools for configuration management.

It may be noticed that at least three of these types of tools (project management, documentation aids and configuration management tools) should be part of a complete I-CASE-environment. Apparently most users prefer to rely on tools that have been specifically designed for these purposes rather than wait for this functionality to be included in the CASE-tools. A final remarkable observation is that $\pm 40\%$ of respondents plans to start using another CASE-tool. If this is simultaneously with the tool currently in use or as a replacement for this tool can not be deduced from the data.

11: Conclusions

In this final section the main conclusions that were drawn from the survey are summarised.

11.1: Appreciation of the tools

A remarkable observation can be made with respect to the rating of the tools. If one only looks at the overall rating, we see a fairly lacklustre picture. All tools are rated ± 7 , a sign that they are not found wanting, but on the other hand not signifying any degree of enthusiasm.

If however the answers to several other questions are taken into account a different picture emerges. Asked for the degree of importance of the tools for the development organisation a large number of responding organisations indicate that this importance is 'substantial' or even 'essential'. Also when we look at the degree in which the tools are expected to be used in the future most organisations predict an increase.

Compared to the expected future usage of other tools it can even be claimed that CASE-tools are among the most popular tools available. Combining this information we can only draw the conclusion that the CASE technology is evaluated very positively and in most systems development organisation without doubt is an accepted part of the software development environment.

11.2: Usefulness of CASE

The main advantages of CASE-tools are to be found in the areas of improving the quality and the maintainability of systems documentation. The four objectives that were valued most can be found in this sphere. That the tools aid in improving quality and maintainability of the system to be developed is less obvious. These objectives are rated lower, but still sufficiently positive that we may safely infer that advantages in this area are obtained.

How these advantages are judged depends on the point of view taken. If one thinks that quality is a mainly technical problem that can be solved by the introduction of the proper methods and tools then the results obtained are clearly disappointing. However it is our opinion that quality is a very complex phenomena that is influenced by many factors, technical, organisational as well as psychological. Improvement of systems quality can be achieved only by addressing all of these. The introduction of tools, which mainly influence the technical aspects, can therefore not be expected to solve the entire problem.

From this point of view it follows that CASE-tools can only provide a part of the solution. If the respondents conclude that the tools have in fact had a slight but positive influence on systems quality then this

can not be seen as disappointing. In fact, it is all that could have been expected.

Furthermore there is the fact that systems quality is one of the main problems facing the industry. Any contribution towards facing this problem, even if relatively small, will in absolute terms yield a sizable advantage. From this it may be concluded that the contribution of CASE-tools to systems quality is more positive than can be concluded from the data at first glance. A similar case can be stated for the issue of maintainability. In this area too any contribution is more than welcome.

11.3: CASE: a long term view

A very good impression of the way in which users regard CASE-tools can be obtained by looking at the ranking given to CASE-tool selection criteria. Among to most important criteria two groups can be distinguished. On the one hand, as was to be expected, there is a group of criteria which together guarantee the immediate usefulness of the tool. Coverage of techniques used, integration between these techniques and a proper man machine interface are among the most important criteria of this group.

On the other hand there is a group of criteria aimed specifically at the future. Vendor continuity and tool growth potential are among the most important criteria in this group. This gave us the impression that part of the respondents expect the main benefits of CASE-tool technology to appear in the future in a new generation of tools. A remarkable detail here is that these future expectations are focused mainly at the present vendor. Criteria related to emerging standards and frameworks, which might in the long run provide more independence from the vendor and consequently more freedom of choice, are rated poorly.

11.4: General

The most important conclusion that can be drawn from these data is that the CASE-tool technology is there to stay. Nearly all organisations indicate that they will continue using the tools at at least the present level. In most cases an even wider usage is envisaged. Loyalty to the tool currently in use is generally high.

Most organisations seem to head towards a situation in which wide use is made of all types of different tools. CASE-tools take an important place in this situation. Although it was indicated in a previous section that not all objectives aimed for are realised when using the tools apparently sufficient (strategic) reasons for a

continuation towards a further automation of systems development are present.

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