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## Guest Contribution

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# A Pragmatic Approach to Development Information to Provide Service on a Wide Scale

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## 1 Introduction

The rapid technological growth in our time has produced an explosion of information. This, in turn, has spawned information systems based on the use of computers and automated systems. These mechanised devices with their seemingly infinite capacity to store and retrieve knowledge on command have myriad applications. But the use of computer and automated information devices pose serious problems to individuals, groups and societies on an international scale in disseminating the available information. This is even more true in information flow between regions with high information capabilities than in those that have little or none. The information flow between these regions has been varied and frequently haphazard whenever it has existed.

In this context the philosophy for development information speaks to interdependence and humanitarian concern in information flow to various regions of the earth. Information must be perceived as a universal entity. The initial failure of one region and the ability of another to acquire information should not dictate a permanent global demarcation into 'developed and less developed' categories.

## 2 Objectives

The objective of development information is for it to function as an interlinking mechanism between a complex industry of information resources and the users of information. In addition, development information should be a catalytic agent that aims at providing objective clarification in information needs between regions with high information capabilities and those with little.

## 3 Mission

The mission is to strive for a move in all regional, national and international agencies and organisations concerned with information to give full co-operation and assistance in setting criteria and standards, formulating policy,

and assessing the information needs of a given region of the world. Development information is capable of realistically assessing information related to socio-economic development in the light of the unique requirements of world regions in need of information and information technology.

## 4 The Dynamics of Information Processing

The proliferation of information technology production has resulted in the growth and development of an ever expanding information packaging industry. This area has become so large in size and scope that it is necessary to discuss some of the important developments that are taking place in the area.

The newest phrases now being used in information packaging range from electronic archives, compact discs (CDs), computer tapes, microfiche, teletexts, video discs, magnetic tapes and interactive imaging systems (optical systems) to word processing and the use of laser technology. Developing countries will not escape this new wave of information packaging. It soon will be bombarded with vendors of these products, to a point where some adaptation will be inevitable.

Assuring the quality of technical processes and the accuracy of packaging information is becoming an increasingly difficult task. Rapid increases in the volume of information, the sophistication of information uses, and the complexity of material flows and processes are characteristic of most modern technical environments. As complexity increases, the risk of introducing significant errors into material processes increases. The very complexity of such systems makes the detection of error itself a complex task. With increasing frequency, public and private organisations are seeking help from corporations with experience in quality control and information validation to ensure that technical process and information packaging meet performance and accuracy standards. The problems association with quality control and validation can be minimised by following these guidelines:

- Establishing ways of aiding in planning, organisation and control of software purchasing and development

through

- creating a directory of software suppliers
- evaluating the quality of software supplied
- keeping abreast of the state-of-the-art in software production
- Providing leadership in the innovative use of software materials and the utilisation of extensive market research on software before making a major purchase
- Establishing cost-efficient ways of packaging and designing your own software by learning how to design and evaluate software for your own use

Preparation for these new technologies for packaging information ought to be made in institutions of higher learning. Perhaps it would be timely to introduce some of these concepts in technical institutes in order that future demands imposed by the new information technology may be met.

The successful growth of developing countries information technology will ultimately depend upon the commitment of substantial resources, especially financial resources. The successful application of this information technology will require more than the mere receiving and storing of it. In addition to the tasks of acquiring and organising informational materials, channels must be established to analyse incoming information. Too much of the information technology that does get transferred out of the industrialised nations is never utilised because it is unsuited for the consumption of users in developing countries. A great deal more effort must be made to analyse, package and disseminate materials on existing and forthcoming information in all vital areas of work and study so that these technologies will be accessible to the developing countries' information-user communities.

## 5 The Need to Establish a Consortium

Information technology specialists need to establish a consortium of regional, national and international information networks and associations. The consortium could be an open structure inviting any institutions, organisations and agencies existing for the purpose of forming a network or documentation clearinghouse and of providing information technology not as an end-product but as a means for human change.

The element common to all membership is an interest in and dedication to providing useful and accurate information that can bring about humanistic change. Equally important is a commitment to the development of relevant information resources to meet the needs of regions with low information capacity.

The philosophical outlook of the consortium would therefore be to crystalise and emphasise broad knowledge, deep understanding, and imaginative efforts, including a dedication to great ideas in providing accurate solutions to the information needs of various regions on an international scale.

## 6 The Organisation of Services for Members

The ideas constituting a conceptual framework for a service-oriented consortium are as multitudinous as the Kalahari sands but in this instance the consortium could function to:

- support creative change within its membership
- facilitate and support new educational enterprises and programs addressed to meet the needs of previously disenfranchised persons
- develop and implement co-operative programs and projects among its members
- provide a meeting ground for a diversity of persons, institutions, and agencies with common values and purposes
- provide a forum for the exchange of ideas among its member associates
- encourage methods of solving social problems
- influence public policy to be consistent with its mission and purpose.

## 7 An Appraisal of Internet

While casual observers have the leisure to observe unobtrusively the growth and development in Internet to be a world-wide phenomenon in information sharing, they do so at no cost. On the other hand, information specialists have to judge and weigh the work of an ongoing Internet program and estimate its usefulness as a network or networks to their daily operations. Information specialists are, therefore, still more sceptical about the scope and magnitude of the Internet. They alone are facing challenges of adding another performance task of being evaluation researchers of Internet in order to provide objective clarification of incorporating Internet as an integral component of their information system. This can be a tedious undertaking because it entails not only knowing how to navigate the Internet network but also cognisance of the following key factors:

- how appropriate the Internet is to your information environments
- to what extent the databanks provided through Internet are relevant to the mission and objective of your environment
- what the relationship is between costs and benefits of having Internet at your disposal

All these factors need to be addressed to determine the effectiveness of Internet in any given information environment, be it in a government setting or in other work environments.

## 8 Training in Information Networks

A seminar for the network should be designed to launch the co-operative exchange of knowledge and experience with

information accessibility and utility of the participant's respective information holdings. To succeed in this effort, the organisers will marshal appropriate interdisciplinary experts and technical resources from within the regions involved. The content of the seminar will consist of information related to formalising and establishing a plan for information networking. It is important that information ministries achieve a high level of knowledge and sensitivity to the information needs of their individual country, region, and ultimately the world, in order to assess, prescribe, design, manage and evaluate the most appropriate uses of information technology for enhancing the advancement of their world countries.

Although the organisers will determine who will be invited to participate in this seminar, special effort will be made to ensure that representatives come from a diversity of backgrounds, and have some knowledge or experience relating to information systems. Additionally, consideration will be given to the level of information technology which is currently utilised by the representative's country.

The content of the seminar will be tailored to meet the specific needs and issues designated by the participants through a pre-seminar survey and needs assessment, which will be administered by the organisers.

## 9 Summary

The above aims at presenting some possible scenario and does not pretend to be exhaustive. The issues, however vital to development information, are given cursory treatment here. It remains important for the luminaries in this area to expand on some of the thoughts contained above.

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## Research Articles

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# Critical Success Factors for Implementing CASE at a Selection of Companies in South Africa

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### Abstract

*CASE, or Computer Assisted Software Engineering, provides the potential for a future in which computer programs will be generated automatically from business rules, but many potential buyers have adopted a wait and see attitude.*

*This study explored some of the issues which will need to be addressed by companies embarking on an Upper CASE implementation programme.*

*Thirteen South African companies who had implemented Upper CASE were selected on the basis of their high profile reputation in the IT field. Of these, some were known to have been successful, and others less successful, in their implementation. The research hypothesised various critical success factors regarding company commitment and determination; communication, extent of participative management and acceptance of change; and methodology and training issues.*

*Findings of the research confirmed most of the minor hypotheses. In the view of the researcher, the major issue overlooked by a number of unsuccessful companies was the importance of involving developers in the CASE acquisition process. Another important finding of the research suggests that companies which are not in an integrated CASE environment will only be at best partially successful, as the major benefits are only achieved if there is a single, common, fully functional repository.*

**Keywords:** CSF, Critical success factor, Upper CASE, Integrated CASE

**Computing Review Categories:** D.2.2, K.6.1

## 1 Introduction

CASE, or Computer Assisted Software Engineering, provides the potential for a future in which computer programs will be generated automatically from business rules and processes. Despite the promise of CASE, the potential buyers have been very conservative, and most have adopted a wait and see attitude.

This study explored some of the issues which will need to be addressed by companies embarking on a CASE implementation programme. The scope of the research was limited to the "Upper" CASE environment. This report summarises the project and the results of the work, the intention of which is to provide senior IS management with non-technical guidelines for the implementation of CASE. The guidelines are developed as a set of critical success factors. Critical success factors, henceforth CSF's, for a company are the limited number of areas in which results, if they are satisfactory, will ensure successful competitive performance for the company [14]. They are the few key areas where "things must go right".

## 2 Background to the Study

CASE evolved as a result of a situation in the late 1970's, when in most companies the demand for new applications was rising faster than the IS department could supply [10]. Observers in the early 1980's regularly cited figures such as three years as representing the "application backlog" in a typical company. As a result many users did not waste their time issuing requests on IS, and the "invisible backlog" came into being. The invisible backlog was more than one and a half times the size of the official backlog [10].

Computer industry analysts in the early 1980's predicted that unless there were significant increases in programmer productivity, the United States would need 28 million programmers by 1992 [9].

The earliest commercial CASE tools date back only to 1982 [12]. Tools only really came to prominence in 1985 with the development and introduction of a number of workbench products for systems analysts. In this period, the IT industry got particularly excited with the promise of CASE, and it was realised that a major benefit of CASE would be the savings in the *maintenance* phase of the development life cycle. Maintenance accounts for about 80

percent of all software development activity [5, 15]. In perspective, this translates [15] to some two and a half million commercial programmers around the world who spend no less than 80 percent of their time maintaining existing systems, rather than developing new programs. The promise of CASE is that huge productivity improvements will free programmers to engage in more development and less maintenance.

Various tools available addressed discrete components of the overall systems development requirements. *Lower CASE* was the term given to tools providing support for the later life cycle stages (of systems development), especially code construction and testing [2]. *Upper CASE* tools offer assistance during the early life cycle stages of analysis and design [2]. Tool developers introduced bridges to interface "Lower" and "Upper" CASE tools with limited success.

Market interest in CASE began to decline in the early 1990's, partly as a result of the paucity of success stories. Other trends in the industry have provided some relief to the application backlogs in companies. These are the shift towards the use of packages, and the trend towards outsourcing. *Applications development* is the major IT activity outsourced in the USA [13].

User disenchantment with CASE has led to a decline in purchasing plans [3]. In 1991, CASE was chosen as the number one emerging technology of interest to IS directors in the USA, with 76 percent of the sample naming CASE. In 1993, only 17 percent of IS directors surveyed said CASE was one of the three emerging technologies of interest to them currently. However, most South African companies with IS departments believe CASE tools will be used extensively in the 1990's [17].

There is now an established world-wide base of CASE users, and sufficient experience has been gained, that the measurement of actual benefits being realised by CASE has commenced. One such study [16] reported that the benefit considered to be the most important (easier modification of preliminary designs) is also the most highly realised. A higher quality system is deemed a very important, but as yet unrealised, benefit. The major vendors are now claiming their products are *integrated CASE (I-CASE)* tools, which are systems that generate applications code directly from design specifications. These tools support both the earlier and later stages of the life cycle [2], and their effectiveness is largely realised through the *repository*. The repository is the link between the graphics, data definition and code generation facilities [4]. Without a (single) repository, specifications pass between tools, rather than being shared among them [11].

The question which most readily arises is why some companies are succeeding with their CASE implementation while others are not. Despite the capabilities that current CASE tools offer, the benefits cannot be achieved if CASE is not effectively assimilated and deployed within the organisation [1].

### 3 The Research Hypotheses

During the literature review it became clear that there were not only various product functionality issues but also a large number of cultural / management issues influencing CASE implementation success or difficulty. It was decided to limit the scope of the project to the cultural / management issues as they would, at least in South Africa, assume a greater importance than the product functionality issues. The reason for this is that the average buyer of a CASE tool in South Africa has had to cost-justify a major expenditure and will have investigated the capability of the product thoroughly. As one manager interviewed explained,

"A CASE tool (and other software) in this country can be three times as expensive as elsewhere as a result of the unfavourable exchange rate. If someone in the USA wants a CASE tool he goes and buys one from a software supermarket for a price lower than his discretionary spending limit. You can't buy goods at that price in South Africa unless you've got approval, therefore you first establish that it does what you expect."

The literature suggested various conditions were critical to the successful implementation of CASE, and these were grouped into the four headings of

- Commitment and determination,
- Company communication, participative management and acceptance of change,
- Methodology, and
- Training.

In detail, the hypotheses were that the factors for successful implementation of CASE, are

#### **Commitment and Determination.**

- Successful CASE sites are invariably early adopters of new technologies.
- There is strong support from senior management.
- Management is committed to the success of CASE.
- Successful companies regard CASE as strategic, and critical for success.
- A product "champion" is necessary.
- The company is prepared to make a substantial financial commitment to help CASE implementation succeed.
- All or most CASE expenditure items such as consultancy were adequately budgeted for.
- The first CASE project is modest and small.

#### **Company communication, participative management and acceptance of change.**

- Developers and end-users communicate openly.
- Developers and managers communicate openly.
- Management must be kept informed and involved in the CASE adoption process.
- Developers must be involved from the outset.
- Successful companies regard change as inevitable.
- Management successfully and deliberately avoids intervention at certain stages.

### Methodology.

- The methodology was installed before CASE.
- The methodology was and is mandatory.
- The methodology was altered after CASE installation.
- The methodology is accepted by the developers.
- The (new) methodology has a good fit with the CASE tool.
- The methodology is not over-prescriptive, too static, incomplete or imprecise.

### Training.

- The company regards training as critically important.
- Every (development) user was trained.
- Training was timeous.
- Training did not just focus on the mechanics of the tool.
- The training budget was adequate.

Some of these detailed items review the ability of the company to assimilate change, and the hypotheses suggest that all (or almost all) managers and workers should participate in (or be represented in) the process and design of organisational change, and not just be affected by it [6].

## 4 The Research Method

The method selected to gather data was to conduct comprehensive, structured interviews with senior managers in information technology or information systems departments of companies who were known to have attempted implementation of CASE. The companies considered for interviewing were chosen primarily as a result of their reputation in the information technology industry, being respected as companies using one or more modern technologies and methods. Of these companies, some were known to have been successful, and others less successful, in their CASE implementation programme.

Thirteen companies were interviewed, nine being in the Gauteng area and four in the Western Cape. Most of the companies would rank in the top 100 companies in South Africa, ranked by turnover or assets.

Interviewees were information systems managers or their direct subordinates

Interpretation of the results was based mainly on the answers as provided, supplemented by the researcher's own view of what the interviewee was really trying to convey. In some instances the researcher used his own judgement and intuition to assess issues such as whether the interviewee was a modest person, set higher (or lower) than average standards of accomplishment, or intentionally provided strategically correct answers.

Only after an interview had been analysed was it possible to judge (subjectively) whether the company was a successful CASE implementer. After all of the interviews had been transcribed, the collated results were revisited to determine frequencies of issues for successful, partially successful and unsuccessful companies.

The measure of successful, partially successful and unsuccessful is an assessment of the researcher, based mainly on the interviewee's comments, in particular the interviewee's degree of satisfaction, which in turn is based mainly on actual results compared to expected. The seniority of most interviewees was such that their degree of satisfaction was based largely on the extent of accomplishment of "General Management" criteria, as defined in [7], including cost/benefit analyses or perceptions. The "actual compared to expected" gap would be particularly important in determining "satisfaction" in this sample, as CASE tools offering significant benefits to one organisation may be insufficient or inappropriate to another [8]. Other issues influencing this subjective measure of "success" included the company's determination to succeed, their expectation of the growth in usage, whether CASE was abandoned, and the degree of problems experienced.

Based on the preceding method, the researcher categorised the companies as follows:

Successful companies:	four companies.
Partially successful:	three companies.
Unsuccessful:	six companies.

No significance should be attached to the relative proportion of the above figures. The companies were deliberately chosen by the researcher to have a reasonable balance of successful and unsuccessful companies. Preconceived views were either ratified or altered after the interviews.

## 5 Findings

The structured interviews resulted in many of the hypothesis items being strongly supported, and other issues emerged. Those items that were strongly supported by three or all four of the successful CASE implementing companies, are shown in Table 1, together with the percentage of the thirteen companies interviewed, who supported the individual items.

### Commitment and determination

Companies successfully introducing CASE regard it as a strategic, important direction actively supported by management, not merely a tool within a methodology. Virtually all companies had a CASE "champion", either when interviewed or when implementation first took place. The "champion" in successful companies, however, was always at I.S. Manager level, or an influential person who received strong support from senior management. This status was not always present in less successful CASE implementing companies.

Successful companies all advised that their budgeting had been adequate, and any overruns on budget were in the "consultancy" category (which was used not only for advice but also to supplement the manpower resource).

A hypothesis item that was unsubstantiated by the research was that the first CASE project is modest and small. This was only true in two of four successful companies and seven of thirteen companies overall.

Table 1. Strongly supported hypothesis items

Hypothesis item or finding	% of successful companies	% of all companies interviewed
<b>Commitment and Determination.</b>		
Successful CASE sites are invariably early adopters of new technologies.	100	54
There is strong support from senior management, who are committed to the success of CASE.	100	85
Successful companies regard CASE as strategic, and critical for success.	100	54
A product "champion" is necessary.	100	92
<b>Company communication, participative management and acceptance of change.</b>		
Developers and managers communicate openly.	100	85
Management must be kept informed and involved in the CASE adoption process.	100	69
Developers must be involved from the outset.	100	77
<b>Methodology.</b>		
A methodology was installed before CASE.	75	77
The methodology recommended by the CASE tool supplier was used after CASE implementation.	100	92
The methodology was and is mandatory.	100	62
The methodology is accepted by the developers.	100	69
The methodology is not over-prescriptive, too static, incomplete or imprecise.	100	77
<b>Training.</b>		
Every (development) user was trained.	100	77
Training was timeous.	100	85

#### Company communication, participative management and acceptance of change

All successful and partially successful companies, but a minority of unsuccessful companies, advised that senior management is being kept informed of progress at all stages of the CASE adoption effort. One qualified that the emphasis had shifted away from reporting on CASE *per se*, to the application project itself. One of the companies who do not keep senior management informed, advised that they (senior management) were more concerned with "bigger issues."

Ten companies reported that the development users were involved from the beginning of the acquisition process. This included all successful and partially successful companies. Most stated that some, but not all, developers had been involved, and that it would have been impossible or impractical to involve all developers in the process. One further interviewee claimed that the developers had been

involved with the acquisition, but detailed questioning revealed that it was only himself and some business users who were involved.

Development staff resisted the change to CASE if it was thrust on them by a committee or management decision that did not have a meaningful representation from the developers themselves. This is a lesson information systems staff have been learning since the 1960's when they attempted to impose systems on users who had been insufficiently consulted. Although IT staff have learned this lesson when considering systems for end-users, they tend to overlook these rules when purchasing tools for a user who is also an IT developer.

The hypothesis item to determine whether management deliberately avoids intervention at various stages was not substantiated in any of the companies interviewed.

### Methodology

A mixture of formal and informal methods and methodologies prevailed in the companies interviewed, before they attempted CASE implementation, with no discernible trend. After the introduction of CASE, however, all successful and partially successful companies had standardised on the methodology recommended by the CASE vendor. This was in line with the philosophy that companies change to new methodologies, and CASE products are just tools within the overall methodology. By implication, and ratified by the appropriate question, use of the methodology was mandatory with and after CASE implementation.

### Training

Time and costs spent in training developers in successful companies, was in excess of 20 days and R10 000 per developer. This included some methodology training, as in all companies, developers were trained in the methodology as well as the CASE tool. All developers who would be using CASE had been trained, and the training had been done by experienced staff from the vendor.

Less successful companies spent less on training (than the above figures), did not train all staff who needed the training, and in some instances used own staff (trained but not experienced) to train others.

### Other findings

In addition to the above CSF's an additional CSF was identified: *The ability to achieve totally integrated solutions, including generated code and a single repository, was a significant issue mentioned by all successful companies, and the inability to accomplish this was frequently an issue for unsuccessful companies.* Therefore, although the intention of the research was to search for CSF's for the implementation of Upper CASE, successful Upper CASE users were also Integrated CASE users, and the unsuccessful companies either did not use Lower CASE or had experienced difficulties and limitations when attempts were made at integrating Upper and Lower CASE. Integrated CASE users are finding that their productivity benefits occur at the code-generation phase, but users with free standing Lower CASE tools are not claiming CASE productivity improvements.

Regarding implementation planning, all successful and partially successful companies advised that their plans had been ambitious.

## 6 Implications for Management

Companies embarking on a CASE acquisition and implementation path need to have ongoing enthusiasm and support from senior management. A reluctant or indifferent attitude from above will not result in a successful project. Accordingly, the principal recommender must ensure his own manager is totally convinced of the medium and long term benefits the company can accrue.

Relative to other countries (predominantly USA) where research of this nature has been done, some se-

nior managers in South Africa appear to be less involved in the process of providing ongoing support to the CASE implementation process, and this is to the detriment of the implementation.

The major issue overlooked by implementing companies is the importance of involving developers with the CASE acquisition process. A single representative from the development staff team is not adequate for this purpose.

The methodology and the CASE tool "fit" is such that it is recommended that the latter is a subset of the former, and use of the methodology needs to be mandatory.

Training budgets should provide for at least three weeks training, by professionals, for all developers who will be using the product.

An issue revealed by this research is the advantages of an Integrated CASE environment. Multiple repositories and the consequent interfacing required, are proving unacceptable to development managers. Companies confining themselves to acquiring Upper CASE tools are likely to be dissatisfied in the medium term.

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The prime purpose of the journal is to publish original research papers in the fields of Computer Science and Information Systems, as well as shorter technical research notes. However, non-refereed review and exploratory articles of interest to the journal's readers will be considered for publication under sections marked as Communications or Viewpoints. While English is the preferred language of the journal, papers in Afrikaans will also be accepted. Typed manuscripts for review should be submitted in triplicate to the editor.

### Form of Manuscript

Manuscripts for *review* should be prepared according to the following guidelines.

- Use wide margins and  $1\frac{1}{2}$  or double spacing.
- The first page should include:
  - title (as brief as possible);
  - author's initials and surname;
  - author's affiliation and address;
  - an abstract of less than 200 words;
  - an appropriate keyword list;
  - a list of relevant Computing Review Categories.
- Tables and figures should be numbered and titled.
- References should be listed at the end of the text in alphabetic order of the (first) author's surname, and should be cited in the text in square brackets [1–3]. References should take the form shown at the end of these notes.

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