

**South African
Computer
Journal
Number 18
December 1996**

**Suid-Afrikaanse
Rekenaar-
tydskrif
Nommer 18
Desember 1996**

**Computer Science
and
Information Systems**

Special Edition: Computer Security

**Rekenaarwetenskap
en
Inligtingstelsels**

**The South African
Computer Journal**

*An official publication of the Computer Society
of South Africa and the South African Institute of
Computer Scientists*

**Die Suid-Afrikaanse
Rekenaartydskrif**

*'n Amptelike publikasie van die Rekenaarvereniging
van Suid-Afrika en die Suid-Afrikaanse Instituut
vir Rekenaarwetenskaplikes*

Editor

Professor Derrick G Kourie
Department of Computer Science
University of Pretoria
Hatfield 0083
dkourie@dos-lan.cs.up.ac.za

Subeditor: Information Systems

Prof Lucas Introna
Department of Informatics
University of Pretoria
Hatfield 0083
lintrona@econ.up.ac.za

Production Editor

Dr Riël Smit
Mosaic Software (Pty) Ltd
P.O.Box 23906
Claremont 7735
gds@mosaic.co.za

World-Wide Web: <http://www.mosaic.co.za/sacj/>

Editorial Board

Professor Judy M Bishop
University of Pretoria, South Africa
jbishop@cs.up.ac.za

Professor R Nigel Horspool
University of Victoria, Canada
nigelh@csr.csc.uvic.ca

Professor Richard J Boland
Case Western Reserve University, USA
boland@spider.cwrv.edu

Professor Fred H Lochovsky
University of Science and Technology, Hong Kong
fred@cs.ust.hk

Professor Ian Cloete
University of Stellenbosch, South Africa
ian@cs.sun.ac.za

Professor Kalle Lyytinen
University of Jyväskylä, Finland
kalle@cs.jyu.fi

Professor Trevor D Crossman
University of Natal, South Africa
crossman@bis.und.ac.za

Doctor Jonathan Miller
University of Cape Town, South Africa
jmiller@gsb2.uct.ac.za

Professor Donald D Cowan
University of Waterloo, Canada
dcowan@csg.uwaterloo.ca

Professor Mary L Soffa
University of Pittsburgh, USA
soffa@cs.pitt.edu

Professor Jürg Gutknecht
ETH, Zürich, Switzerland
gutknecht@inf.ethz.ch

Professor Basie H von Solms
Rand Afrikaanse Universiteit, South Africa
basie@rkw.rau.ac.za

Subscriptions

	Annual	Single copy
Southern Africa:	R50,00	R25,00
Elsewhere:	\$30,00	\$15,00

An additional \$15 per year is charged for airmail outside Southern Africa

to be sent to:

*Computer Society of South Africa
Box 1714 Halfway House 1685*

Guest Contribution

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

Stephen S Mncube, PhD

*Divisional Manager: Development Information Services, Centre for Policy and Information,
Development Bank of Southern Africa*

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.

Bibliography

1. A D Burnett. *Technology for information in development: proceedings of the sixth conference of the International and Comparative Librarianship Group of the Library Association*. International and Comparative Librarianship Group of the Library Association, Brighton Polytechnic, Falmer, Sussex, August 21-23 1987.
2. M Cook. *Guidelines on curriculum development in information technology for librarians, documentalists, and archivists*. Paris Unesco, 1986.
3. O Fairfax, J Durham, and W W. *Audio-visual materials: development of a national cataloguing and information service: Report of a joint feasibility study for the british library and the council for educational technology*. Distributed by Councils and Education Press, 1976.
4. M Fransman. *1948 - The market and beyond: Cooperation and competition in information technology development in the Japanese system*. Cambridge University Press, New York, 1990.
5. N K Hanna. *The information technology revolution and economic development*. World Bank Discussion Papers, World Bank Washington DC., 1991.
6. N Heaton and L W MacDonald. *Human factors in information technology product design and development*. Ellis Horwood, 1991.
7. T Koizumi and G E Lasker, eds. *Advances in education and human development: new trends in learning and teaching evolution of human systems and institutions, individual freedom and sociopolitical controls in the high technology environment of the advanced information society*. International Institute for Advanced Studies, Baden-Baden, West Germany, 1990.
8. V Sethi. *The development of measures to assess the extent to which an information technology application provides competitive advantage*. Ann Arbor: MI, University Microfilm International, University of Pittsburgh, 1988.

1. A D Burnett. *Technology for information in develop-*

SACJ is produced with kind support from
Mosaic Software (Pty) Ltd.

Business Process Reengineering: A Down to Earth Critique

Tarun Shewaram

Department of Information Systems, London School of Economics and Political Science

Abstract

'Change' is a universal phenomenon that many take for granted. Without change time has no meaning. Even people are essentially dynamic processes, we are constantly changing in multitudinous ways. In light of this, it is reasonable to suggest that organizations are even more dynamic as they are in essence a collective of varied personalities, both internal and external, that interact to form highly complex, evolving entities. Organizations today face acute economic pressures, and rapid rates of technological change. Unsurprisingly, the need for effective techniques to manage organizational and environmental change has never been as urgent as it is today. This paper offers an informative review of one such technique which has dominated management thinking in the 1990's, Business Process Reengineering (BPR). Although BPR is currently the subject of much academic criticism, it is still being employed as a set of organizational change practices in much of the commercial western world. What follows provides an interpretation of the BPR prescription according to its leading proponents, it then addresses the many issues related to the ambiguous nature of the validity of BPR, and that of its current practice. In short, this paper attempts to offer an overview of the 'BPR phenomenon'.

Keywords: Business Process Reengineering, Process Orientation, Michael Hammer, James Champy, Socio-Technical School

Computing Review Categories: K.6.0, K.6.1

1 Introduction

This paper starts with an interpretation of what BPR entails according to Hammer and Champy (Section 2). The ambiguity relating to its uniqueness is addressed by analyzing it against socio-technical principles of design, and drawing out implications of the comparison (Section 3). A brief case study is presented in order to highlight the significance of the above implications (Section 4). The next section discusses the effects on the phenomenon of BPR rhetoric and reasoning (Section 5). This is followed by a brief look at the current state of BPR practice (Section 6). Finally, conclusions are drawn out which relate to BPR, and to the general field of management (Section 7).

2 BPR as presented by Hammer and Champy

Hammer and Champy [3] present their case as follows. They first identify what they see as the fundamental drives behind the need for radical transformation of organizations. They outline the three C's which they suggest characterize the crisis faced by "Corporate America". Firstly, they conjecture (the word conjecture is used as they argue this largely with hypothetical examples) that "since the early 1980's, the dominant force in the seller-customer relationship has shifted". The suggestion is that customers have taken charge. Secondly, they argue that the competition faced by contemporary organizations has intensified. New entrants are more competitively flexible, markets have globalized, and the increasingly varied role of Information Technology (IT) is changing the nature of competition. And finally, they argue that 'change' has become constant. For

commercial organizations, the persistent nature of change has become a normality. As they themselves put it, "the only predictable constant has already become rapid and relentless change". These three C's described above have placed the modern organization in uncertain and unfamiliar territory that demands radical transformation in order to deal with impending threats to survival.

In order for organizations to be capable of engaging this crisis a prescription is required. Hammer and Champy outline what they call "the path to change". BPR means "starting over", it is defined as "the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical, contemporary measures of performance, such as cost, quality, service and speed". Hammer and Champy argue that 'fundamental' questions need to be addressed in order to force people to look at the tacit rules and assumptions that underlie their business. Redesign needs to be 'radical' in order to get to the root of things, discarding all existing structures and procedures and inventing new ways of doing work. Changes need to be 'dramatic' in order to achieve "quantum leaps" in performance. And furthermore, all this must be based around the key to BPR, an emphasis on 'processes'. Hammer and Champy define a process as a "collection of activities that takes one or more kinds of input and creates output that is of value to the customer". Traditionally, organizations use the ideas dating back to Adam Smith which suggest that work should be split up into the functional tasks it comprises, but combining tasks into single processes, Hammer and Champy argue, provides the cohesiveness to yield value directly for the customer. And customer value is of paramount importance.

Hammer and Champy go on to identify three types of

organizations that can reengineer, the first of which are in deep trouble and thus need 'order of magnitude' improvements. They have no choice. The next are not yet in deep trouble but anticipate major problems in the near future. And the last are organizations in peak condition, with no problems. They have so much time on their hands that their 'ambitious and aggressive' management can use BPR to raise the competitive bar as such.

According to Hammer and Champy, the path to change via reengineering entails certain common themes. The first is process orientation as described above. The next is ambition in attempting to achieve huge improvements in performance. Rule-breaking is also a theme that characterizes reengineering. Conceding that all previous ways of working are probably inappropriate in today's environment. Acknowledging that "tradition counts for nothing". And finally, reengineering is about the creative and innovative use of IT.

At this stage, Hammer and Champy also address the issue of organizational bureaucracy. They argue that without it chaos would result. "Bureaucracy is the glue that holds traditional corporations together". They suggest that it has been the solution to the problem of fragmented processes. It's elimination will be achieved by flattening organizations through reengineering processes such that they are no longer fragmented.

Now as processes are the focus of BPR, Hammer and Champy describe common characteristics of reengineered processes as a guide to rethinking and redesigning business processes.

Several jobs are combined into one. The distinct tasks traditionally associated with assembly line work are integrated and combined into one. They are compressed horizontally as such. This leads to fewer errors and hand-offs thus speeding up turnaround times. This also implies that individuals may have knowledge of entire processes which is highly useful and which does not tend to occur with traditional assembly line type fragmented processes. Hammer and Champy use formal terms such as 'case worker', which describes an individual who is responsible for the whole of a value creating process, and 'case team', which describes a collection of workers who are responsible for the whole of a value creating process.

Workers make decisions. This indicates the vertical as well the horizontal compressing of work. Instead of approaching supervisors for help, workers make decisions for themselves. Decision making is now a part of the work and thus requires that workers are more knowledgeable and responsible.

Steps in processes are performed in a natural order. Traditional hand-off processes require a linear sequence, i.e. the completion of one stage before the initiation of another. But, according to Hammer and Champy, if the natural order of a process does not specify this imposed linearity, reengineering can help exploit the potential benefits of 'de-linearising'. They argue that this also reduces the window within which any major external changes could render any completed work obsolete.

Processes have multiple versions. Traditionally all inputs are handled identically in order to facilitate the provision of uniform and consistent outputs. In the modern business environment companies need a variety of output to cater for the needs of differentiated markets, differentiated consumers within markets and so on. Hammer and Champy's argument is that if case workers (or teams) are responsible for their work they can be flexible within processes in order to cope with variable requirements, for example, large orders requiring complex work as well as smaller orders requiring simple work. Traditional 'one-size-fits-all' processes are averaged and therefore cause inefficiencies at the extremes. Processes with multiple versions can irradicate these inefficiencies.

Work is performed where it makes the most sense. Traditionally work is centered around specialists which creates organizational barriers. Hammer and Champy use the example of an accounting department buying pencils through the purchasing department and thus incurring greater costs for the processing of a simple transaction. Reengineering processes tends to shift work across such organisational barriers employing the principle that the customer of a process can perform some, or even all, of the process thus reducing costs and hand-offs. Though in some situations work is better accomplished by handing it back to the supplier. Hammer and Champy cite an example of a truck manufacturer that lets its tyre supplier manage its tyre warehouse as the tyre supplier possesses the relevant expertise. The general point here being that reengineered processes tend to cross such inefficient barriers.

Checks and controls are reduced. Hammer and Champy argue that excessive resources are wasted on checking and control functions within processes. According to Hammer and Champy, the attitude consistent with reengineered processes is to accept some losses resulting from less stringent checking. The rationale behind checking and control in reengineered processes is that of economic necessity. They don't feel that it is worthwhile to conduct relentless checks at all stages. Reengineering processes reduces the chances of receiving inconsistent data via the reduction of external contact points which minimizes the need for reconciliation also.

The case manager is the single point of contact. Hammer and Champy consider case managers useful for complex or dispersed processes where it would be value adding for the customer to have a single point of contact as opposed to having to resort to navigating their way around, what to them is, an unfamiliar process. As the case manager becomes the only person that the customer will deal with, he/she needs to be endowed with responsibility for the entire process. So in effect, case managers are 'empowered' customer service representatives who, Hammer and Champy claim, "can get things done".

Hybrid centralized/de-centralized operations are prevalent. Hammer and Champy argue that reengineered processes can combine the advantages of centralization with those of de-centralization. For example, sales personnel in the field using notebook computers connected to the head

office via wireless modems are autonomous in the sense that they have access to any necessary information, and are controlled as the parameters governing their work are built into the common software that they utilize. Hammer and Champy state that "IT increasingly enables companies to operate as though their individual units were fully autonomous".

BPR, as advocated by Hammer and Champy, causes radical transformations in an organizations internal environment which results in what they call 'the new world of work'. They suggest that this is characterized by the following changes.

Works units change from functional departments to process teams. As steps are now performed in a natural order, and as work is now conducted where it makes the most sense, functional walls are removed and multiskilled process teams are the norm. Types of process works units include case teams (which were described earlier), virtual teams (which are temporary case teams), and case workers (which were also described earlier).

Jobs change from simple tasks to multi-dimensional work. The nature of process teams is such that they are responsible for the end product of the process. Hammer and Champy argue that this forces team members to 'see the bigger picture' and thus unites the team into striving for a better end-product. Individual members have some familiarity with all steps of the process, not just their own. Hammer and Champy argue that this aids in removing all non-valueadding stages such as checking and control, and that it improves job satisfaction as well as creating a more challenging and educative work environment.

Roles change from controlled to empowered. Hammer and Champy suggest that all reengineered roles are empowered ones. Teams that perform process oriented work are likely to be self-directing and self-ruling. According to Hammer and Champy, process teams are characterized by the lack of a need for supervision. This dictates that workers will have to be hired subject to stricter, more demanding criteria.

Job preparation changes from training to education. In this context Hammer and Champy claim that traditional companies only train their employees. Reengineering, they argue, requires workers to be educated in order for them to be able to cope with multi-dimensional work and added responsibility. Training teaches workers how to do things, whereas education teaches them why they are doing these things. Reengineered roles are loosely defined and companies need people who are capable of figuring out what a job requires and providing exactly that. In essence, workers need to create their slot as opposed to filling a pre-determined slot. Furthermore, this slot is subject to continuous change.

The focus of performance measures and compensation shifts from activity to results. The argument here is that assembly line type work within functional departments is difficult to quantify. Thus, performance measures and pay tend to reflect how much time the worker has sacrificed or the number of 'joints' he/she has soldered i.e. activity. In

reengineered environments the focus can naturally be on results. Hammer and Champy advocate a system which would pay process workers static flat rates topped up with substantial rewards for outstanding performance in the form of bonuses, not raises'. The approach to compensation they suggest is similar to the one employed in sales departments where the top worker could earn more than the sales executive. Hammer and Champy also suggest that the focus of advancement criteria should be changed from performance to ability. They believe that often workers are promoted into managerial roles without the necessary abilities purely because of their exceptional performance rates. In essence, they believe that if an employee is extremely good at his/her job, why promote him/her to a managerial position.

Values change from protective to productive. Workers should harbor a belief that the work they are doing is primarily for the customers, and not for their bosses. Hammer and Champy suggest that in order to shape employees values and beliefs, the organization's management systems must support the mission statement. Even the highest level executives must be seen supporting the company's values and beliefs.

Managers change from supervisors to coaches. Reengineering leads to complex processes becoming simpler, and simple jobs becoming more complex. Thus, managers need to handle fewer links and can spend more time helping employees do the harder job. As a large part of the traditional managers work becomes the work of the process team, the nature of the managers work changes to that of a coach. Furthermore, process teams need this.

Organizational structures change from hierarchical to flat. Hammer and Champy argue that due to process teams conducting their own process management, fewer managers are required. They suggest that less "managerial glue" is required.

Executives change from scorekeepers to leaders. A flatter organizational structure implies that the executives are closer to the workers and the customers. This combined with the increased job complexity and greater responsibility faced by workers, Hammer and Champy argue, requires encouragement and inspired leadership from the executives. They are responsible for ensuring that processes are designed in such a way as to enable workers to do the required job, and to motivate them via the management, performance measurement, and compensation systems of the organization.

Hammer and Champy outline the role of IT in BPR as follows. It is an essential enabler and the key to applying it is 'inductive thinking'. They suggest that one should attempt to recognize powerful solutions in IT, then find the problems that those solutions might solve. Their advice to companies is not to improve current practices through IT, but instead to use IT to conceive new practices. They warn that this is one of the most difficult aspects of BPR. The argument used to justify these suggestions hinges on 'Say's Law' i.e. supply creates its own demand. They suggest that new solutions which result from IT and which solve unrecognized problems will be successful as their supply will

generate demand for them. Hammer and Champy cite the example of photocopying technology to make their case. According to them, needs as well as aspirations are shaped by people's understanding of what is possible, "the challenge that most corporations fail to meet is recognizing the business possibilities that lie latent in technology". They go on to suggest that one should find the long-standing rules that technology allows the organization to break, then analyze the business opportunities that are created by breaking those rules, "the real power of technology is not that it can make old processes work better, but that it enables organizations to break old rules and create new ways of working—that is, to reengineer". They see this disruptive power of technology as emancipatory. The approach they advocate here is not one which endows companies with the luxury of choice. According to Hammer and Champy, in order for an organization to be successful it needs to be at the cutting edge of technology, "companies need to make technology exploitation one of their core competencies if they are to succeed in a period of on-going technological change".

3 A Comparison with the Principles of Socio-Technical Design

The following is a list of nine critical principles of socio-technical design collated by Albert Cherno [2]. It represents the "distillation of experience" of many writers of the socio-technical school, which dates back to the 1960's. Their juxtaposition here with the fundamentals of BPR represents an attempt at correlation in order to address the ambiguity relating to the uniqueness of reengineering (as presented by Hammer and Champy).

1. Compatibility.

'The process of design must be compatible with its objectives'. This principle suggests that the workers who will be doing the jobs being designed should have input in that design process i.e. it advocates participative design. Furthermore, this school of thought acknowledges the need for some advance design, the extent of which is addressed by the second principle.

2. Minimal critical specification.

This principle has two equally significant implications. Firstly, that no more should be specified than is absolutely essential (the negative aspect). And secondly, that what is essential must be identified (the positive aspect). The fundamental notion here is that once the necessary advance specifications are established, the rest should be left to the people in question. Cherno suggests that the specifications should be aimed at informing workers what they have to do, as this is probably necessary, but not how they should go about it. Rules on how goals should be achieved are inhibiting.

3. The socio-technical criterion.

Variances are defined as unprogrammed events. If they cannot be eliminated, they should be controlled as close to their point of origin as possible. An exam-

ple of variance elimination is the inspection function which, according to this principle, should be incorporated within the process in question (not in a separate department) so that people can inspect their own work and learn from their mistakes. This has the additional effect of reducing the number of communication links across departments. The principle advocates less supervision and control which leads to a greater degree of 'job completeness', i.e. people are allocated objectives and provided with the resources necessary for their attainment, including the appropriate information.

4. The multifunctionality principle.

Traditional organizational forms require that people become parts doing highly specialized, fractionated tasks. This makes them easily replaceable, but as a result inhibits the range of responses that they are capable of producing. This principle advocates giving people multifunctional roles and is consistent with the notion of minimal critical specification.

5. Boundary location.

The socio-technical approach suggests that the control of activities within any department should be the responsibility of the members of that department, and that this would in turn allow their supervisor to concentrate on boundary activities thus ensuring that the team had adequate resources to achieve its objectives. This principle implies that people should be autonomous with respect to their jobs, and that their supervisors should help coordinate their activities with the other parts of the process to which their tasks belong. Under favorable conditions, workers may even manage their own boundaries thereby streamlining the role of the supervisor to the level of a 'resource'.

6. Information flow.

Information systems should provide the appropriate information at the origin of its needs. This principle is fundamental in the sense that the information system must be consistent with all of the other principles and must function in accordance with the guidelines they yield. For example, information provision should be in appropriate locations and such that users can control variances and so on.

7. Support congruence.

Systems of social support should be designed so as to reinforce the behaviors that the organizational structure is designed to elicit. Payment, selection, training, promotion, work measurement, and all such systems need to be designed such that they reinforce the desired behaviors i.e. the management philosophy should be in line with management actions.

8. Design and human values.

An objective of organizational design should be to provide working life of high quality. Jobs should:

- be challenging and varied,
- be a continual learning experience,
- be endowed with responsibility in decision making,
- be supported and recognized,

- relate content and output to social life,
- present opportunities for progression (not necessarily promotion).

9. Incompletion.

This final principle may be the easiest to state, but it is perhaps the most difficult to comprehend and accommodate for within any organizational design process. It implies that design is a reiterative process, "at the end we are back at the beginning" [2]. As soon as design is implemented, its consequences indicate the need for redesign.

Let us now consider the similarities between BPR and the socio-technical approach.

Principle two implies, much in the same way as BPR does, that work roles should be loosely defined. People should be given objectives and left to their own devices. Principle three suggests that the inspection function should be incorporated within the process in question, and not conducted in separate departments. BPR also advocates the inclusion of controls and checks within the processes themselves. And again in line with the fundamentals of BPR, this principle implies that less supervision is required in favor of increased autonomy and adequate resource provision. Principle four, once more in line with BPR, implies that workers doing fractionated tasks only is inappropriate. People ought to be given multifunctional roles. This also allows for what Hammer and Champy refer to as processes with multiple versions. Principle five is within its own context similar to BPR. It suggests that people should be autonomous with respect to their work, and that under favorable conditions, the role of the supervisor becomes that of a resource. The implications of principle six are also in line with BPR. Information systems are required to play a fundamental role in supporting the functioning of autonomous work groups with complex informational needs. The utilization of information must also be efficient. Principle seven, that of support congruence, advises that an organization's management philosophy should be consistent with its management actions. BPR would also seem to imply that this is a prerequisite for organizational design success.

Since the principles of socio-technical design discussed above are firmly rooted in works dating back some thirty years, the major implication of these similarities is that a large part of the reengineering prescription is, in fact, not original, but instead borrows in significant depth from other schools of thought, the collection of which are known as the 'Socio-Technical School'. This view would seem to be supported by Matthew Jones of the University of Cambridge who suggests that "while approaches which describe themselves as BPR, or ally themselves with it, may have an important contribution to make to organizational change, it would not seem attributable to any single conceptual breakthrough, despite the claims of some authors". The main emphasis of BPR is said to be on 'process thinking'. Though if one considers the assertions made by principles three through six, it is clear to see that although not overtly stated, the socio-technical approach definitely utilizes the

same concept.

Let us now consider the key differences between the two approaches.

Firstly, BPR is top-down and expert led, i.e. it is "always born in the executive suite" [3]. Its nature suggests that its roots are in a deterministic view of organizational change. BPR could perhaps be described as a model for change consistent with 'Taylorism', whereas, the socio-technical design approach advocates participative design processes i.e. is bottom-up.

This leads neatly to the second major difference between the two approaches. BPR defines in advance the desired outcome of organizational change, whereas, socio-technical design principle number nine clearly states that design is a reiterative process. It implies that organizational change is a dynamic process.

Another major variance within the approaches is in the treatment of power. BPR views power as a commodity rather than as a property of relationships between agents. It suggests that power can be distributed in a controlled way. In contrast, the socio-technical approach only asserts that jobs, and thus workers, should be endowed with responsibility in decision making.

The views of IT adopted by the two approaches are also critically differentiated. The BPR approach suggests that organizational change is driven by IT, that the technological infrastructure is installed first, followed by the necessary organizational arrangements. Hammer and Champy devote an entire chapter to discussing the 'enabling role of IT' in which their advice is to "find the long-standing rule or rules that technology allows the company to break, and then see what business opportunities are created by breaking these rules" [3]. They suggest that "as an essential enabler in reengineering, modern IT has an importance to the reengineering process that is difficult to overstate" [3]. The socio-technical approach, on the other hand, describes the efficient use of IS (not simply IT) as necessary, but only second to the organizational change itself. The difference seems to be a matter of what comes first.

The final respect in which the socio-technical approach differs from the reengineering approach is in its underlying emphasis on a concern for people. The two approaches offer a similar prescription, but BPR lacks a concern for people. Socio-technical design principle number eight outlines characteristics which are common to both approaches, but the socio-technical approach designates them as objectives, whereas, in BPR they are a by-product.

The implications of the relative differences between BPR and the socio-technical approaches are discussed below. BPR's emphasis on a top-down, expert led approach based on scientific management tends to neglect the 'people' aspects of organizations such as culture, power, politics, social structure and so on. It assumes that employee behavior can be isolated and changed individually. This approach is unlikely to succeed in accounting for all of the contingencies that may arise during the process of organizational change. As Bjorn-Andersen and Turner [1] suggest, "change needs to start at the periphery of an organization,

and ought to be led by small ad hoc groups focused on the work itself”.

Now as organizational change is generally considered to be a dynamic process, the static approach adopted by BPR i.e. defining the outcome in advance, will not suffice. Bjorn-Andersen and Turner suggest, in line with the socio-technical approach, that “ends need to emerge as a result of the change process itself”.

Hammer and Champy’s attempt to use the word empowerment to imply that the distribution of power is controllable, and furthermore, that empowerment is the route to the emancipation of workers is inconsistent with the emphasis placed by BPR on ‘strong leadership’. As we mentioned earlier, Hammer and Champy claim that “reengineering is always born in the executive suite”. As Matthew Jones [4] suggests, “this apparent compatibility of empowerment with an executive led and controlled process would seem to suggest, therefore, that it does not involve any significant relinquishment of management authority (except perhaps by some unfortunate middle managers), let alone its seizure by sub-ordinates, organized or not”. Jones refers to Kling and Hirschheim (1994), who go one step further and suggest that empowerment may reflect the handing down of responsibility in a hierarchy, but that it is not to do with emancipation as understood by ‘critical social theorists’. This view is consistent with the socio-technical approach of endowing jobs, and thus workers, with ‘responsibility’.

The emphasis placed by BPR on the enabling role of IT which is, as Hammer and Champy put it “difficult to overstate”, would most definitely seem to suggest that in reengineering, organizational change is driven by IT. This characteristic of BPR is in clear contrast to the socio-technical approach and it is plausible to suggest that it may perhaps be responsible for some of the many BPR failures. As Bjorn-Andersen and Turner [1] argue, “the number of instances where technology has been used successfully as the driving force behind large-scale organizational change are few”. Furthermore, Hammer and Champy’s prescriptive set of measures which describe how to use IT to improve work processes would seem to embody a rather simplistic view of the technology itself. In the context of organizational change, IT cannot simply be viewed as “isolated, socially-neutral items of hardware and software which can be analyzed independently of their social context” [4]. Instead, IT becomes part of collections of equipment which are social objects, “highly charged with meaning” (Kling, 1992 in [4]). According to Jones, “even while describing technology as permitting or inducing organizational change rather than driving it, the BPR literature may be seen as treating IT as separable from the social relationships within which it is employed”. He goes on to argue that “such a moderated form of determinism would seem inadequate in its approach to organizational change and to neglect the complex social character of the process”. Some authors have even gone as far as to say that BPR is “just a way for IT companies to sell more IT” (Warren, 1993 in [5]).

All of the above implications of the relative differences between the two approaches carry more weight in light of the fifth set of differences discussed earlier. The socio-technical approach starts and finishes with ‘people’. The BPR approach can be described as relatively ‘narrow-minded’ in only considering the bottom line. The socio-technical perspective is clearly that of organizations (even commercial ones) existing primarily for people as well as for profit, whereas, the BPR perspective is quite clearly that of commercial organizations concerned with market power and profit making who employ people to achieve their objectives.

4 A Brief Case Study

The transformation experience of the Danish hearing aid manufacturer Oticon has received considerable attention within the field of management. It is presented here as an illustration of how major organizational change requires more in-depth considerations than those suggested by BPR. The view adopted here is that the organizational design changes implemented at Oticon are more in line with the socio-technical approach than with BPR. A brief description of the changes and their subsequent impact is presented, followed by a discussion on how the Oticon experience either differed from, or went beyond, BPR. (Source: [1]).

Through sluggishness in keeping up with market trends active in the 1980’s, Oticon lost its place as the market leader and started to make losses. The new CEO implemented cost-cutting measures to bring Oticon back into the black. Even when all the potential benefits of cost-cutting had been realized, Oticon still only occupied a relatively weak position within the industry. This led the CEO to engage in a major restructuring (in 1990) of the head office in Denmark which involved the following changes:

- the elimination of traditional departments,
- the reorganization of work into the form of projects,
- the reorganization of employee roles to encompass several positions,
- a new control philosophy.

Two pre-requisite strategies were implemented in order to facilitate all of the above. Firstly, a new open-plan office layout with no private desks was created. This yielded the working flexibility required at Oticon. And secondly, 95% of all paper was eliminated in favour of workstations, common applications, individual memory and scanners. This helped Oticon achieve the level of informational efficiency demanded by the above changes. (NB: for a more detailed account of the changes please consult [1].)

After an initial loss in 1991, the profits for 1992 soared to nine times that of 1989 and 1990. Since then, sales have been continuously increasing and the time to market for new products has been significantly reduced.

The Oticon experience either differed from, or went beyond, BPR in the following ways.

BPR advocates process redesign as the first step to

organizational change. At Oticon, the vision was different, "it was a radical statement of what the company wanted to be" [1], i.e. as the CEO stated, "be the number one hearing aid company by 1997". Furthermore, this was backed up by 'a consistent set of strategies for getting there'. Bjorn-Andersen and Turner [1] describe this as 'holistic vision'.

Focus was on employees rather than business processes. Bjorn-Andersen and Turner suggest that concentrating on redesigning business processes only, promotes efficiency at the expense of innovation and flexibility, and furthermore, is not conducive to massive change. At Oticon, the prime focus was on enhancing the motivation of each individual employee. The idea was to remove barriers to employee performance, and to provide workers with enhanced productivity tools so that they would perform better as individuals, and in a manner consistent with the interests of the company. The intention was also to improve the quality of working life.

At Oticon, worker commitment to change was gained through positive motivation. BPR, by instilling the fear of job losses into workers, tends to use negative motivation. Oticon employees were given shares in the company, and the CEO skillfully stimulated media stories about the company which led to the workers being subjected to a great deal of positive attention.

The organizational change process at Oticon was participative as opposed to the top-down, expert led BPR approach. Some authors have argued that participation is inappropriate for radical changes as employees will not sacrifice themselves. Oticon has to some extent proved this wrong by involving workers in the entire transformation process. The change process at Oticon could not possibly have been driven by an external entity such as a consultancy as the primary focus of the change was employee motivation.

Before the changes at Oticon occurred, its working culture was decisively 'elitist'. There were five levels of company cars depending on a person's managerial level. The radical transformation that took place asked a great deal of the workers, this clearly demanded a more egalitarian culture.

As we discussed earlier, the fundamental driver of change in reengineering seems to be IT. At Oticon, IT was never the starting point of the change. The visions of change were formulated without any detailed analysis of IT in mind. Even so, Oticon made highly innovative use of IT. The uses and impacts of IT were in line with the predictions of BPR, but the difference lay in the order of importance. At Oticon, the implementation of a vision of organizational change was followed by the construction of an IT strategy to 'complement' it, whereas, the BPR prescription seems to describe a situation where the implementation of an IT strategy is followed by the construction of an organizational strategy to 'supplement' it. In Oticon's case, the relationship between its organizational and IT strategies is clearly characterized by 'synergy' (for detail consult source), whereas, in a classic example of BPR as Hammer and Champy describe it, one could argue that

an organizational strategy is crudely fused together with predetermined process redesign and IT strategies.

To sum up, the emphasis at Oticon on employee focused change, worker commitment, participative design, and organizational culture, clearly demonstrate a far more in-depth consideration of the human perspective when compared to the BPR approach. The mode of IT utilization at Oticon also contradicts the BPR prescription. Finally, the emphasis on holistic vision also indicates the extent to which the instigators of change at Oticon acknowledged the sheer breadth of considerations that need to be accounted for when attempting radical organizational change.

5 BPR Rhetoric and Reasoning

In September 1994, a CSC survey (Information Week) of six hundred managers revealed that 69% of North American companies, and 75% of European companies were all boasting at least one BPR project. In January 1995, the CFO journal revealed that only 16% of executives were fully satisfied with their BPR projects, and that 68% were experiencing unanticipated problems. Furthermore, Markus and Riley reported that consultants publicly state a BPR failure rate of 70%. These statistics certainly indicate the need for an elaboration on the nature of the BPR phenomenon.

Let us start by considering the crisis of which Hammer and Champy talk. Their claim that since the early 1980's customers have taken charge lacks in substance as they do not support it with any convincing evidence. Matthew Jones suggests that "if Hammer and Champy's argument for the new power of the customer is rather unconvincing, however, its inclusion as a symptom of the crisis that BPR addresses is unlikely to be accidental". With respect to their claim that competition is intensifying, Enid Mumford believes that it is not a 'global' economy which corporations are faced with, but instead an 'international' economy which is characterized by less open competition. And finally, their claim that change has become constant seems to indicate a degree of hypocrisy on their part since they are conveniently offering what they portray as a universal solution to the problems posed by this dynamic and critical crisis. In short, Hammer and Champy's argument seems to be selective in its presentation of the crisis, and exaggerated in its portrayal of its urgency. Jones argues that "the way that the crisis is presented by Hammer and Champy may be seen as specifically designed to point to BPR as the answer". He argues further that, "a more cynical, or ideological analysis could even question whether the crisis really exists".

The crisis in question is not the only point on which BPR is sold. It is even sold on the past failures of organizational change measures that it advocates. Jones suggests that BPR writers confront these past failures so as to "clear the air". He goes on to argue that "whether this argument convinces many managers wavering in their decision on whether to go for BPR is unclear, but it would certainly

seemed designed to reassure beleaguered technocrats that their faith has not been misplaced" [4]. This attempt to put BPR beyond scrutiny is further strengthened by the admission in the literature of high failure rates. Jones suggests that the 'violence' of some of the language used by Hammer and Champy may also serve a purpose in selling the concept, i.e. advise such as "don't automate, obliterate" [3] is a clear indication of this. Hammer and Champy also seem to cover their tracks by using the 'year zero' concept to imply that the so-called revolution that is BPR will not be bloodless. They imply that without pain there is no gain. Whether this is true is not as significant as the manner in which it has been used to disarm criticism and to sell BPR. Hammer and Champy also emphasize the need for courage and vision in order to survive implying that failure may be attributable to personal weakness and not a deficiency in the approach itself. Jones quite accurately suggests that "in the nature of faiths, Hammer also seeks to disarm criticism by describing reengineering in a way that places it beyond scrutiny. Such comments should not be taken to imply that BPR is somehow dishonest or even exceptional, but that its impact may not be wholly attributable to the effectiveness of the practices it promotes". In light of Hammer and Champy's claim that the alternative to BPR for corporate America is "to close its doors and go out of business" [3], one might even endeavor to suggest that they are employing 'scare tactics' to sell their prescription. Enid Mumford refers to the work of psychologists to suggest that this type of persuasive communication which uses threats and arouses disturbing emotions can be highly effective in selling a concept.

6 A Brief Look at the Practice of BPR

The statistics referred to earlier indicate the extent to which BPR has been adopted by organizations both in the US, and in Europe. Furthermore, a great many articles have been written on the subject since 1990. Jones suggests that "despite all this attention, the concept remains surprisingly ill-defined and has received relatively little academic scrutiny". No standard BPR methodology exists. Jones argues that the concept is 'interpretively flexible' i.e. it means different things to different actors based on their 'structures of signification'. Therefore, Jones argues, as certain actions are described as BPR, and the term BPR is used to describe actions, "the actors also serve to reproduce and modify these concepts" [4]. This view is consistent with Enid Mumford's suggestion that Dawkin's theory (see source) on how ideas are transmitted and in the process distorted, applies to the BPR phenomenon. This has led to a broad range of concepts and practices being termed as BPR. The effects of this ambiguity have been amplified by the lack of substance in the original case for BPR, "the fact that Hammer did not offer any detailed methodology himself, left consulting firms with the opportunity for using their old and familiar analytical tools and techniques and calling these reengineering" [5]. Consulting firms were not

the only vested interests who contributed to this dilution of the original concept, "senior managers could claim they were reengineering their firms, while leaving this to the consultants. The consultants could claim they had reengineering methodologies while using current techniques, and the third interested party, the computer vendors could sell the hardware and software essential to the process" [5].

At present, a major concern is that with the BPR market as large as it is, with an estimated compound annual growth rate of 46% [4], second-rate versions of a concept which has been on shaky ground since its conception, may emerge in significant numbers. Jones suggests that "the influx of charlatans willing to pass off dubious imitations of the real thing is likely to debase the coinage even if it has some intrinsic merit". E. Deevy takes a more critical view of current BPR practices, he suggested (24th Oct 1995, in the Boston Globe) that US business was paying out \$20bn per year to consulting firms for poor advice. He argues that these consultants have turned reengineering into a gold rush. He advises that, "reengineering is a fad that needs to be abandoned. What is needed is commitment to the workers who hold the key to success in the future". If what he suggests is true, then the current association of BPR with downsizing is extremely daunting for these workers.

7 Conclusions

The established principles of socio-technical design show that BPR is certainly not original. The phenomena identified by Hammer and Champy are part of broader patterns of social and organizational change "that cannot be solely attributed to, and will not be resolved by changing, the functional structure of organizations" [4]. BPR adopts a deterministic view of organizations and thus ignores the people aspects of change. Furthermore, it does not account for the dynamic nature of organizational change processes. BPR is distinctly IT driven and embodies a simplistic view of technology where artifacts are separable from their social context. The overall focus of BPR is not people, but profit. The Oticon experience demonstrated the sheer breadth and depth of change required in the successful implementation of 'radical' organizational transformation. It highlighted BPR's limited view of the world.

Hammer and Champy draw an exaggerated picture of crisis and support it with the skillful and effective deployment of rhetoric geared towards selling BPR. The overall emphasis of the case for BPR is that of no alternative. The nature of its argument is such that it promotes 'organizational anorexia' by enticing companies to search for, and irradicate, problems that don't really exist. This is clearly demonstrated by Hammer and Champy's suggestion that even companies that are in 'peak condition' should in effect risk it all in an attempt at 'radical transformation' so as to 'raise the competitive bar'.

Finally, we must conclude that the field of management urgently needs to make a critical assessment of itself. Van Maanen (1989) argues that the success of many of today's

management theories may be attributed more to the quality of their rhetoric, than of the empirical evidence on which they are said to be based. If one considers Pascale's (1990) illustration of more than two dozen examples of 'management fads' between 1950 and 1988, one wonders about the scale of resource wastage that has been incurred in the process of promoting and using these concepts. The power of their combined effect is also astonishing, "the idea that organizations are in crisis is such a commonplace of much current management literature that it would seem almost dis-respectful to question it" [4]. Jones suggests that the 'hype' is perhaps necessary in order to elicit a major impact, but this author is inclined to disagree. If the tonic works then sooner or later people will start to use it. Modern business seems to be forgetting that patience is indeed a virtue. Society as a whole cannot afford to waste resources in an impetuous manor. In the specific case of BPR, the size of the current market indicates the extent of resource wastage that may be occurring. If we consider the fact that in 1995 the majority of major US companies were engaged in at least one BPR project, alongside the findings of an ISR survey of 350,000 US employees which found that between 1990 and 1995, the percentage of workers worried about being laid off rose from 20% to 44%, it is also clear to see the level of displacement caused in peoples lives.

The Wall Street Journal interviewed both Hammer and Champy in early 1995. While discussing the problems of reengineering, they were asked, "what about those who don't survive?", Champy replied "there will be five to ten years of very difficult displacement", and Hammer replied "there will be a lot of people who will never find a job again". It is clear to see that the rise of this particular management fad has been at the expense, both directly and indirectly, of many. The moral of this story would certainly seem to be that 'all is fair in love, war, and reengineering'.

References

1. Bjorn-Anderson and Turner. 'Creating the twentyfirst century organisation: The metamorphosis of oticon'. In *Transforming Organisations with IT*. North Holland, (1994).
2. A Cherns, ed. *The Social Engagement of Social Science: A Tavistock Anthology*, volume 2. 1993.
3. M Hammer and J Champy. *Reengineering the Corporation: A Manifesto for Business Revolution*. Harper Business, 1993.
4. M Jones. 'Don't emancipate, exaggerate: Rhetoric, reality and reengineering'. In *Transforming Organisations with IT*. North Holland, (1994).
5. E Mumford and R Hendricks. 'Reengineering rhetoric and reality'. Lecture given at the LSE, 1996.

Received: 2/96, Accepted: 10/96, Final copy: 11/96.

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.

Manuscripts accepted for publication should comply with the above guidelines (except for the spacing requirements), and may be provided in one of the following formats (listed in order of preference):

1. As (a) \LaTeX file(s), either on a diskette, or via e-mail/ftp – a \LaTeX style file is available from the production editor;
2. As an ASCII file accompanied by a hard-copy showing formatting intentions:
 - Tables and figures should be original line drawings/printouts, (not photocopies) on separate sheets of paper, clearly numbered on the back and ready for cutting and pasting. Figure titles should appear in the text where the figures are to be placed.
 - Mathematical and other symbols may be either handwritten or typed. Greek letters and unusual symbols should be identified in the margin, if they are not clear in the text.

Contact the production editor for markup instructions.

3. In exceptional cases camera-ready format may be accepted – a detailed page specification is available from the production editor;

Authors of accepted papers will be required to sign a copyright transfer form.

Charges

Charges per final page will be levied on papers accepted for publication. They will be scaled to reflect typesetting, reproduction and other costs. Currently, the minimum rate is R30-00 per final page for \LaTeX or camera-ready contributions that require no further attention. The maximum is R120-00 per page (charges include VAT).

These charges may be waived upon request of the author and at the discretion of the editor.

Proofs

Proofs of accepted papers in category 2 above may be sent to the author to ensure that typesetting is correct, and not for addition of new material or major amendments to the text. Corrected proofs should be returned to the production editor within three days.

Note that, in the case of camera-ready submissions, it is the author's responsibility to ensure that such submissions are error-free. Camera-ready submissions will only be accepted if they are in strict accordance with the detailed guidelines.

Letters and Communications

Letters to the editor are welcomed. They should be signed, and should be limited to less than about 500 words.

Announcements and communications of interest to the readership will be considered for publication in a separate section of the journal. Communications may also reflect minor research contributions. However, such communications will not be refereed and will not be deemed as fully-fledged publications for state subsidy purposes.

Book reviews

Contributions in this regard will be welcomed. Views and opinions expressed in such reviews should, however, be regarded as those of the reviewer alone.

Advertisement

Placement of advertisements at R1000-00 per full page per issue and R500-00 per half page per issue will be considered. These charges exclude specialized production costs which will be borne by the advertiser. Enquiries should be directed to the editor.

References

1. E Ashcroft and Z Manna. 'The translation of 'goto' programs to 'while' programs'. In *Proceedings of IFIP Congress 71*, pp. 250–255, Amsterdam, (1972). North-Holland.
2. C Bohm and G Jacopini. 'Flow diagrams, turing machines and languages with only two formation rules'. *Communications of the ACM*, 9:366–371, (1966).
3. S Ginsburg. *Mathematical theory of context free languages*. McGraw Hill, New York, 1966.

Contents

GUEST CONTRIBUTION

- A Pragmatic Approach to Development Information to Provide Service on a Wide Scale
SS Mncube 1

RESEARCH CONTRIBUTIONS

- Critical Success Factors for Implementing CASE at a Selection of Companies in South Africa
TM Addison and S Hamersma 4
- The Homological Transfer Research Method Revisited
C Koornhof 10
- Business Process Reengineering: A Down to Earth Critique
T Shewaram 15
- Dynamic Deadlock Avoidance: A Prototype
CN Blewet and GJ Erwin 24
- An Integrated Classification of Multiple Database Systems
K Renaud and P Kotze 32
- An AI Search Algorithm to Obtain The Shortest Simplex Path
TG Scott, JM Hattingh and T Steyn 40
- The Complexity of Petri Net Transformations
SR Donaldson, F Bause and PS Kritzinger 45
- The Practice of Clausification in Automatic Theorem Proving
G Sutcliffe and S Melville 57
- Correction (Hoffman, SACJ 17) 9

COMMUNICATIONS AND VIEWPOINTS

- The new IS'95 Curriculum
DC Smith A69
-