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South Africa, as a developing country, needs to find ways to harness it's enormous potential in a rapid and sustainable way. It is argued by some that the developments in information technology are increasingly creating opportunities for socio-economic development to be enabled by the diffusion of IT. If this is true, then these opportunities should surely be explored. Consequently, the editorial board of SACJ has decided to devote a special issue to this theme.

Some of the questions that the special issue might address are:

- To what degree can information technology enable (or accelerate) socio-economic development?
- How can the diffusion of information technology be achieved in order to maximize its contribution towards socio-economic development?
- What are the conditions required for such technology enabled development?
- Are there high leverage areas where quick returns can be achieved?
- Should the state play an active role and in what way?
- What are the experiences of other developing countries in information technology enabled socio-economic development?
- What are the moral and ethical issues involved in information technology enabled socio-economics development?

We invite *all* researchers in the field of information technology and other disciplines to contribute to this special issue. All contributions will be reviewed by three independent reviewers. Contributions should be sent in four copies to:

Prof Lucas D. Introna
South African Computer Journal (SACJ)
Special Issue: IT and Development
Dept. of Informatics
University of Pretoria
Pretoria, 0002
SOUTH AFRICA

Contributions should be received by June 5, 1995. Contributions sent by facsimile or e-mail will not be accepted. For any information regarding the special issue contact Prof Lucas Introna at +2712 4203376 (office), +2712 434501 (fax) or Internet: lintrona@econ.up.ac.za.

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The Innovative Management of Information in The Mid-1990s

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Abstract

This paper reviews recent literature on the subject of the operational and financial difficulties facing business and management in the mid 1990's. It identifies how, due to generally poor results, business is under more pressure to perform than ever before. The paper proceeds to indicate how currently accepted business paradigms are no longer working as well as they used to and how, in order to return to appropriate levels of profitability, new paradigms for corporate structure and individual motivation are needed which emphasise renewal and innovation. This theoretical review of the literature finds that business process reengineering is an important way forward towards innovation which also allows organisations to cope with increasingly difficult business conditions.

From a research point of view the paper goes on to suggest a theoretical conjecture concerning the creation of business or management paradigms which might be helpful in improving business performance in the twenty first century.

Keywords: *Innovation, Information Systems Management, Business Process Reengineering, Business Transformation, Virtual Corporation, Managing Change, Business Restructuring.*
Computing Review Categories: *K.6*

1 Introduction

There are several different routes by which organisations arrive at an interest in innovation in the work place and business process reengineering in particular. Some firms are pushed to this subject through economic difficulties, usually declining profits. Others are made aware of the need to innovate by competitive pressures in the market place. But a large number of organisations have applied business process reengineering technology as a way of improving the performance of their efforts to apply information technology (IT). IT performance improvement is in fact regarded as one of the main drivers of business process reengineering.

IT has never been more simple or more complicated than it is today. More simple in terms of the fact that it is now absolutely clear that every individual, every organisation, every group can directly benefit from the use of IT in many different ways. Organisations are spending or investing vast sums in their information technology, while hardware and software vendors are developing highly sophisticated products in the expectation of delivering an ever increasing level of computing power to an apparently insatiable market, the size of which is quite staggering. It is hard to know how big the IT market is and it is also difficult to reach consensus as to what types of products and services should be included in it, but according to Business Week (1993)

> "Throughout the 80s US businesses invested a staggering one trillion dollars ($1,000,000,000,000) in information technology." [4]

Although the above number is indeed large it is believed that the market for IT by the turn of the century will be several trillion dollars per annum. In fact there is no suggestion whatsoever that the growth in the demand for IT will not continue to increase in double digit percentage points for the foreseeable future and thus it will remain one of the strongest markets in an otherwise unstable economic environment.

On the other hand information technology is more complicated than ever before, in terms of the amount of choice, the rate of change and the ability or inability to manage IT in order to show measurable improvement in corporate performance. The choice issue is especially interesting because although there are a growing number of products and services on the market, the stability of some of the old established organisations such as IBM, has come into question for the first time. This has caused some firms, who believed that there was security of continuity in buying from the market leaders, to rethink that premise.

Whereas the past 40 years has been a series of triumphs for the technical side of IT it has in many ways been the opposite for information management. At least since the beginning of the 1990s there has been a distinct reduction in the status of information management in many private and public organisations. Whereas a few years ago IT was seen as a technology which could substantially enhance the firm in a number of ways including improving its efficiency, effectiveness and even deliver competitive advantage [6, 12, 36, 40, 43], today it is seen by many as primarily a problem area. This was especially well highlighted by Lincoln [24] when he said

> "The past few years have seen a marked shift in the attitude of senior executives towards the use of information technology. No longer are expenditures seen as low and investments 'acts of faith'. Now executives require that their information systems are both profitable and can be shown to be profitable."

It is important to bear in mind that the disenchantment with

IT is not a sudden phenomenon nor is it a result of failure in one area. According to Computer Weekly as far back as 1991, information managers have failed their organisations on three counts.

> "Time has run out for IT managers who act like a protected species. Their three-fold failure to understand the business they are supposed to be part of, to communicate with their business colleagues, and to deliver cost effective systems has led to a collapse of faith in the IT department itself." [7]

Of course there is the argument that it is unfair to blame IT managers exclusively for the problems of communication with their business colleagues as it requires two parties to communicate and also cost effective systems require the involvement and commitment of users. But in any case the dissatisfaction with IT has lead directly to action to curtail activity in this business function. This has been expressed by Earl [13] as follows,

> "IT is undergoing heavy scrutiny and sometimes radical surgery. IT budgets are being capped or pruned. Headcounts in the IT function are being rationalised or sold off. IT operations and development are being outsourced. IT directors are being replaced. These are not just reactions to recessionary pressure or changing economics of technology. Chief executives are tiring of IT rhetoric and hype; many of them feel it has been oversold and under delivered."

These are clearly serious comments or charges against information management and the actions described above have been directly felt by virtually all those in the IT industry. Some argue that one of the main reasons for these problems is that information management lost its way by being too concerned about the technology and not enough concerned about the business problems which it should have been solving. This view asserts that we have been mesmerised by the wonders of the technology at the expense of applying it in an optimal way.

This technology focus has resulted in the frequent application of computer systems in superficial ways which has amounted to no more than cost displacement and has thus resulted in negligible, if any, returns on investment. In fact where information systems have not been accompanied by changes in business processes there has often been no return on the funds invested. Earl, supporting this notion, offers advice on how to improve the situation.

> "Concentrate on rethinking business by analysing current business problems and environment change – and by considering IT as one ingredient of the solution not the solution." [13]

However this suggestion of greater focus on business, although absolutely necessary for any effectiveness use of IT, may not be sufficient. Many of the problems attributed to IT and its management must be seen in terms of the general set of difficulties experienced by professional general management in the mid-90s. IT can no longer be treated, or for that matter evaluated, as an isolated function on its own which may be used to support or facilitate business change. Today IT is so central to how business is performed that, for many firms, it is ubiquitous in every aspect of the organisation. Long gone are the days when IT was simply a record keeping or data processing issue. Information management and IT have matured over the past decade to a point where they are key management issues which are much more to do with the functioning or conducting of the business than with technology per se. It therefore follows that if the general management of the business is not performing well it is unlikely that the information management function will be able to do much better. Poor performance at the top of the organisation is likely to be felt in all parts of the firm [1]. Thus to put the performance of information management into context it is necessary to consider the performance of general management over the past few years in the business context as a whole.

2 Managerial Challenge

The last few years have seen a long list of corporate failures as well as the largest business losses ever made. General Motors lead the pack in 1992 at $6B with IBM hard on its heels with a $5.7B loss. 1993 saw a somewhat different picture. In the second quarter alone IBM declared a loss of $8B. Barclays Bank PLC managed to find itself a minor player in this league with losses of only half a billion pounds. These organisations are not alone in their difficulties. There are in fact many famous, household names struggling to survive. These organisations, who are either disappearing or making monumental losses, and have to go cap in hand to the shareholders, find themselves in this position because they cannot deliver either products or services for which their clients are prepared to pay.

Some observers argue that these corporate losses and failures are the result of the economic recession or depression which is said by some to be the worst since the 1930s. However there are others who say that we are not in a recession at all, but rather a restructuring of national and international economies. Specifically it is argued by Professor Warren McFarlan of Harvard Business School that the three million white collar workers currently unemployed in the USA will not find themselves reemployed in similar jobs to those which they used to have, because even if the economy picks up or even recovers, these jobs no longer exist [26]. Various forms of automation have removed the requirement for these people from the system. This sentiment is echoed by Newsweek with the words

> "Workers of the world, be warned. The future will have fewer middle-class jobs to offer. Lifetime careers will be rare. Retraining will be constant." [27]

This disturbing phenomenon is clearly not a temporary phase in the economic cycle but rather a deep structural shift in the economies of the industrialised societies the likes of which has not been seen in living memory. Of course there will be winners as well as losers but the major effect on all will be an unprecedented level of instability and uncertainty in the economic lives of individuals.

It is the contention of the authors that the main reason for the unsatisfactory results of some of the larger firms and the unemployment problems of our society is overwhelmingly the result of poor management at both the corporate and national level. This view is supported by Prahalad and Hamel when they said

> "top management of Western companies must assume responsibility for competitive decline." [35]

As we enter the mid-90s, management in general is clearly in trouble. The precise nature of the trouble with management is not obvious. It is not a matter of there only being one thing wrong. The roots of the problems are deep and complex. What is clear is that managers, corporate and governmental, do not have the tools available to achieve the required results. They do not have the vision required and many of them do not even have the will to deliver the results. According to Davis

> "It is no wonder that we are managing our way to economic decline. Our management models, the context in which we manage, don't suit the context of today's business." [10]

The difficulties which management face today are not new but they have not been quite so easy to see before due to the relatively easy economic conditions of both supply and demand which most managers faced from the 1950s to the late 1980s. It is in fact suggested by a number of authors that the roots of the problems actually extend back to the central management and economic principles on which the industrial revolution was based and which still underpin many of our management practices today. These principles which inter alia, refer to the division of labour and the factors of production, largely played down the role of the individual in the business process to that of a unit of labour. Clearly these concepts were useful in helping to cope with the business conditions of the 18th and 19th century. But ideas which were assets then have by the end of the 20th century become liabilities. Furthermore the view of people's contribution to an organisation as being commodity like was reinforced in the 19th century by the notion of corporate hierarchies which were rapidly institutionalised into western business. Again this concept which was most useful in its day has now become mostly obsolete. This decline in our business and economic thinking is strongly emphasised by Drucker when he says,

> "International economic theory is obsolete. The traditional factors of production – land, labour and capital – are becoming restraints rather than driving forces. Knowledge is becoming the one critical factor of production." [11]

Drucker also points out that the hierarchical structure of modern organisations with six, eight, twelve or even twenty levels of management are no longer relevant in the twentieth century. This approach to business control, which was borrowed from the military and the Catholic Church and which was first introduced into commercial organisations on a large scale by the American railroads in the mid 1800s [9] has to a large extent outlived its purpose.

Figure 1 shows a model of the typical hierarchical organisation in the form of a triangle which is frequently

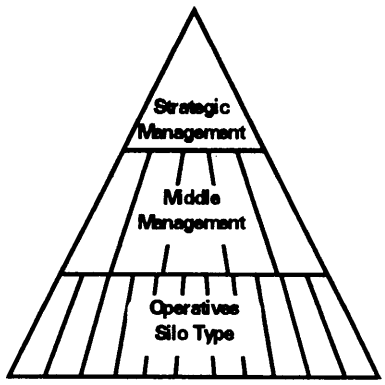

Figure 1. The Anthony Triangle representing the hierarchy in organisations

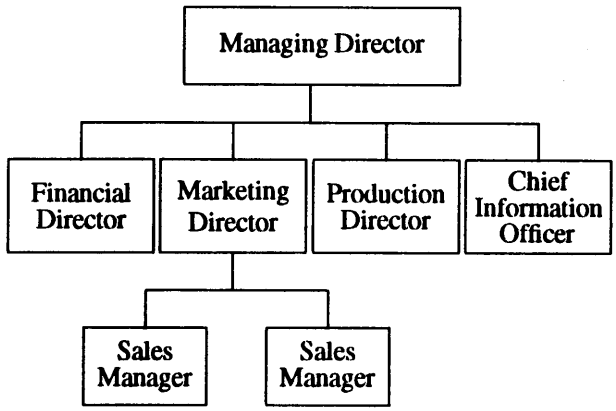

Figure 2. A typical organisational chart

referred to as the Anthony triangle or paradigm. The upper section of the triangle represents senior management who make the strategic decisions. The mid-section of the triangle represents middle management whose main task is to pass on information about the work force to the senior staff. The lower section depicts the operatives or work force.

The hierarchy was designed for command and control purposes in an age when communications were poor and because of the inadequate quality of local management most if not all decisions had to be made by the small team of managers at the head office. A multistaged hierarchy is ideal for transmitting orders from the directors through various levels of the organisation to the workers at the bottom. The hierarchy is also extremely good at collecting data which is passed up the organisation in a progressively summarised form to the top management. Anthony's triangle is better known in most organisations as the organisational chart which is shown in Figure 2.

However, generally speaking, the conditions which made the corporate hierarchy of ten to twenty levels so effective do not exist today and thus organisations with three or four hierarchical levels are much more effective.

In the past few years many organisations have changed their organisational structure as a result of the application of information technology. Information technology has reduced the need for operatives or workers so that the size of the base of the triangle has been reduced. In addition, due to improved communications technology, the size of

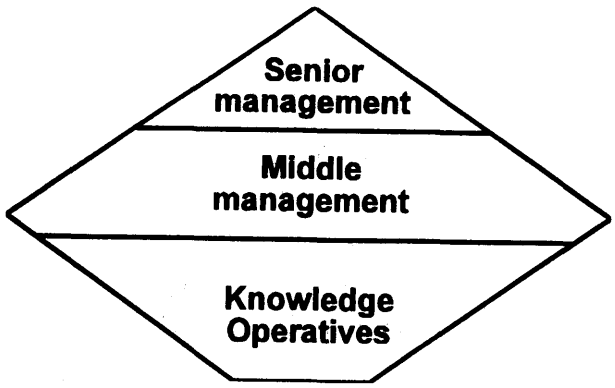

Figure 3. A modified or mutated functional hierarchy

the middle management band has also shrunk. This new form of organiusation is sometimes refered to as modified or mutated functional hierarchy. Both these changes are depicted in Figure 3.

3 Labour as a Factor or the Commoditisation of People

Clearly, if people are just perceived as a commodity, i.e. simply one of the four factors of production, then it is unlikely that they will offer their best effort to the organisation for which they work. This under utilisation and under performance of people is certainly one of the main problems facing our economic and management systems as we move towards the end of the twentieth century. Pascale and Athos pinpoint this unacceptable notion of human labour as one of the factors of production as a key problem.

> "The industrial revolution, with its invention of mass production, diminished the importance of the skilled trades and the social affiliations obtained through them. The emergence of the concept of factors of production (land, labour and capital) had revolutionary implication for the Western view of mankind. Humans (the labour content) were no longer an inextricable part of the organic whole of society. Rather, the person, as labourer, became an objectified and standardised component of the production process. Not surprisingly, the view of 'labour' tended to divorce man as a social and spiritual being from his 'productive' role at work." [30]

It is easy to see that once people have become objectified and standardised the next step is for alienation to develop. This is undoubtedly at the root of much of the industrial relations difficulties experienced in the western world over the past hundred years. But perhaps more important than the commoditisation of people was the idea of the division of labour. Adam Smith established the notion that if tasks were divided up into simple components then much more work could be achieved in the same period of time by the same number of people [30]. This concept of the division of labour was one of the primary driving forces of the industrial revolution and until recently was one of the key reasons for the vast improvements in productivity in the nineteenth and twentieth centuries.

However today the division of labour is seen as having a negative effect on staff with a corresponding reduction in efficiency and effectiveness. It is suggested by Hammer and Champy [15] that the division of labour causes problems of responsibility as well as initiating the need for large numbers of support staff. It is also a primary cause of so many jobs being unfulfilling for the workers.

This repercussion was in fact anticipated by Adam Smith even in the eighteenth century when he wrote in the Wealth of Nations,

> "The man whose whole life is spent in performing a few simple operations, of which the effects too are perhaps, always the same ... has no occasion to exert his understanding, or to exercise his invention in finding out expedients to removing difficulties ... He, naturally, therefore loses the habit of such exertion, and generally becomes as stupid and ignorant as it is possible for a human creature to become." [3]

There is another unfortunate side effect of the division of labour and the commoditisation of people. The customers of business organisations are always people. If the organisation treats people as objects then we tend to see our customers also as objects. Also because tasks have been divided into small tasks, there are few individuals who see the whole picture. This easily leads to a take it or leave it attitude towards clients and customers, which is all too prevalent today. Customer awareness and care is frequently seen as one of the great differences between winners and losers in today's markets.

Another problem relates to the fact that much of our current management thinking and even more unfortunately our current practice, is based on or has been derived from the works of the pioneering organisational theorists such as Taylor, Fayol, Weber and Mayo. The ideas developed from this generation of business theorists, who were working between 60 and 100 years ago, which were absolutely essential to the understanding of organisations in their time, and which were responsible for the magnificent industrial successes such as those achieved by Henry Ford, are largely not relevant today. The differences between owners of capital, entrepreneurs, professional managers and workers, in terms of their skills, education attitudes etc. are nowhere near as great today as they were at the turn of or the early part of the century. Yet many modern management techniques have not taken into account the enormous differences in demography of the work force let alone modern motivation factors, levels of education and the power of the tools which are at the disposal of today's workers. This change in circumstances of the economic environment in which we now live, which requires us to offer an entirely different response to what we had previously felt was adequate, has been most eloquently expressed by Konosuke Matsushita who pointed out that:

> "We (the Japanese) are going to win and the industrial West is going to lose out; there's not much you

can do about it because the reasons for your failure are within yourselves. Your firms are built on the Taylor model, even worse, so are your heads. With your bosses doing the thinking while the workers wield screwdrivers, you're convinced deep down that this is the right way to run a business. For the essence of management is getting the ideas out of the heads of the bosses and into the hands of labour." [30]

To motivate individuals to perform well in today's environment, an entirely different approach is needed to that prescribed by the likes of Taylor nearly one hundred years ago. Unfortunately, as Matsushita pointed out, there are still many firms as well as public organisations who have not yet realised just how much the working environment has changed over the past decade or so.

Finally the notion which still underlies the thinking of some economists, that the main point of business is the maximum of profit, is not helpful. First of all, in most businesses it is either impossible or at least very difficult, to maximise profits. Secondly the notion of profit maximisation suggests that the organisation exists to take advantage of its clients where ever possible. Simply this does not lend itself to relationships of mutual trust and respect which has been the basis of successful businesses in the mid-1990s. With the concept of maximisation of profit as the guiding economic principle, it is hard to envisage the possibility of a strategic alliance between firms.

4 A New Business Environment

Quite simply, the world for which the likes of Taylor wrote just no longer exists. The structure of our society is profoundly different. A list of these differences would require pages. The technology shift is enormous. Our current technology allows us to do things entirely differently to the way in which we did them before. Markets are international if not global. The current business mentality is global. We are forced to think globally by competitors who obtain vast competitive advantage by being able to exploit huge markets. Our ability to create capital is unprecedented. Capital is no longer only concentrated in the hands of a few individuals or families. Knowledge and skills exist in an abundance not dreamt of before. This all adds up to the urgent if not desperate need for an entirely new approach to doing business and especially a new approach to managing people. Nonetheless many of our business organisations attempt to apply Taylorism for a lack of any better model for doing business. In fact there are those who argue that the problem is not so much the tool set which we have inherited from Taylorism, but rather the narrow and restrictive way in which we as mangers have attempted to apply them. This is not the only problem. Many of the currently established business practices are simply not relevant especially when viewed through the potential of the different types of technology available to us today. It is this combination of archaic attitudes towards people and obsolete business practices which is the root cause of the poor business performance today.

5 Sound Business Frameworks

The shortage of sound business theory may be seen by the high surge in the sale of quick management fixes through books telling the tales of how Iococo [22], Harvey-Jones [17, 20, 18, 19] and others performed great feats of management. There have been publications and courses on new management techniques such as *In Search of Excellence* [33] and *The One Minute Manager* [2]. There has been the suggestion that the Fifteen Minute Competitive Advantage is what is needed [23]. The growth in business schools, especially in the UK, offering a wide variety of MBAs not to mention the short executive courses, in the past five years, has been staggering. However, none of these prescriptions seem to have had any substantial impact or lasting effect on management but rather, at best, offer temporary relief to specific situations or problems which exist at particular times.

This lack of a sound conceptual framework for modern business management has been well expressed by Pascale [29]:

"Even today's most careful students of organisations will readily admit that they lack adequate models to predict corporate success. Recall how widely we celebrated such New Age cultures as People Express, Atari, and Rolm. Ardent supporters include academics, consultants, business journalists, and seasoned executives. Our former enthusiasm becomes a source of embarrassment when we hold ourselves accountable for predictive accuracy.

It is no longer permissible to dismiss these reversals lightly, acknowledging once again that "management is an art," and excusing ignorance by giving it another name. The sobering truth is that our theories, models, and conventional wisdom combined appear no better at predicting an organisation's ability to sustain itself than if we were to rely on random chance."

But the problems discussed above are not inherent in all management, nor in management all over the world. Pascale, who is a scholar of Japanese management, points out that many of these difficulties do not exist, at least, to such a great extent, in the larger Japanese companies. But by and large the Japanese have no better technology, or for that matter no greater or more profound insight into organisational dilemmas than western companies have. Pascale and Athos suggest that western firms are in reality limited not by their tools but by their vision [30].

The fact that the Japanese have no greater body of knowledge at their disposal is emphasised by Fujisawa the co-founder of Honda, who pointed out that:

"Japanese and American management is 95 per cent the same and differs in all important respects." [29]

It is not at all clear exactly where this 5% difference resides and how it manages to constitute such an enormous vari-

ance between the two business cultures. However, it has been suggested that the 5% difference between Japanese and American management largely resides in the fact that the Japanese are slower to decide i.e. make decisions, but when they reach a consensus, they are more ready to ensure that their decisions are implemented i.e. *walk the talk*, than are their American or British counterparts.

There are, however, some clues to business success in the west in the middle of the 1990s. According to Sherman writing for Fortune Magazine [38], there are five lessons to be learnt about business management from the changes in computer manufacturing industry. These are:

1. You can't say it often enough: Don't lose touch with the customer.
2. Even in a high-tech industry, management skills are more important than technology.
3. Today's successes often obscure the first signs of failure.
4. The company with the highest unit volume almost always wins.
5. The place to find unit volume is the bottom of the market, where low prices create new customers.

The first two of these points clearly refer to the organisation's attitude towards people which, as described above, is generally lacking in both business and governmental organisations.

However, the third point adds a new dimension to the debate on business performance and its sustainability. Many business theorists focus on one key difference between winners and losers which is alluded to in point three above and which is believed to be one of the most important attributes of the successful organisation. This issue is frequently described by the words *success is probably the most recurring cause of failure*. Expressed differently, business losers tend to find a winning paradigm and then they stick to it. They create a clear formula or model for their success and they ensure that this formula is strictly adhered to. At one level the creation of such a paradigm is a most sensible way to proceed as it simply involves following what has been a previously successful route. This of course would be fine in a static world, which unfortunately does not exist, but when the environment changes the paradigm, instead of being supportive to the organisation's efforts, actually become destructive.

Companies which fall into this category seem to have particular difficulties in observing changes in their environment. According to Senge

> "In most companies that fail, there is abundant evidence in advance that the firm is in trouble. This evidence goes unheeded, however, even when individual managers are aware of it. The organisation as a whole cannot recognise impending threats, understand the implications of those threats, or come up with alternatives." [37]

The main reason for this is that their paradigm for success does not allow them to even perceive that there has been material change in the context within which they had previously been successful. In fact, frequently the paradigm filters out the information which they need to perceive their impending doom.

6 Corporate Renewal or Re-Inventing Oneself

On the other hand, sustainable winners are much more aware of their environments. These organisations engage in the continuous and relentless process of corporate renewal. Winners take nothing for granted, especially their past success. They constantly question many of their basic assumptions, paradigms and theories to ensure that these assumptions have remained valid. Pascale explains this as follows:

> "... the subtle but distinct quality of the survivors is that their organisations become engines of inquiry. Yes they solve problems, but what they do best is harness the forces of the organisation so that they constantly and obsessively question their modus operandi. It is this continual questioning that generates the next paradigm ... and the next ... and the next." [29]

This view had already been identified by Foster [14] who is also a strong advocate of the fact that much of the current business and managerial problems are to be placed at the door of the old paradigms which previously contributed to success. He explained the psychology behind the seekers of new paradigms as follows

> "Their managers (successful firms) have assumed that the day after tomorrow will not be like today. They have assumed that when change comes it will come swiftly. They believe that there are certain patterns of change which are predictable and subject to analysis. They have focused more on being in the right technologies at the right time, being able to protect their positions, and having the best people rather than on becoming ever more efficient in their current lines of business. They believe that innovation is inevitable and manageable. They believe that managing innovation is the key to sustaining high levels of performance for their shareholders."

Corporate renewal, and especially the renewal of business paradigms, appears to be the primary key to sustained success and when one reflects on this it is hardly surprising. The world, in its billions of years of history, has perhaps only one constant which is the fact that it is in a continual state of change. As long ago as 500 BC Heraclitus proclaimed:

> "You could not step twice into the same rivers; for other waters are ever flowing on to you." [21]

Therefore the ever changing nature of the environment is a fact which has been known for some time.

Foster also expressed a more personal aspect of change in the words:

> "We may live at the same number of the street, but it is never the same man who lives there." [14]

Although the world and all the individuals in it are changing continuously it is wrong to believe that change per se, and especially organisational change, is always good. In fact, if not correctly planned and managed, change may be counter productive. Petronius Arbiter cited by Weed [42] pointed out:

> "We tend to meet any new situation by reorganising; and a wonderful method it can be for creating the illusion of progress while producing confusion, inefficiency and demoralisation."

What is being eluded to in the above quotation is the phenomenon of change for change sake which seldom produces useful results. Change needs to be undertaken as part of a plan which is aimed at either improving the effectiveness or the efficiency of the organisation either internally or externally.

Business Process Reengineering

Constructive change, however, is now regarded as the primary way forward for organisations who wish to achieve success and sustain this achievement. Some authors argue that the corporate change efforts should be focused through a programme of business process reengineering which is defined by Hammer and Champy [15] as

> "The fundamental rethinking and radical redesign of business processes to achieve dramatic improvement in critical contemporary measures of performance such as cost, quality, service and speed."

From the above it may be seen that this notion of business process reengineering corresponds quite well to Pascale's and Foster's concept of corporate renewal. In fact Hammer and Champy use the words *reinvent themselves* to describe business process reengineering. They see this activity as starting from scratch i.e. the organisation looks at its situation as though it were a green field and therefore decides how things should be done without having to worry about currently implemented systems. This has the effect of allowing the organisation to discontinue with its history and thereby reinvent itself in the way most suitable to its current circumstances. Supporting the notion that business process reengineering is a fundamental re-evaluation of business and managerial practice, Stoddard [39] describes this approach to change as

> "a direct attack against the principles of functional specialisation and incremental improvement that lie at the very foundation of the industrial revolution."

Thus at the heart of business process reengineering is the belief that it is essential to reverse the thinking which led to the division of labour, to the commoditisation of people and to the development of twenty level hierarchical organisations. None of these concepts are relevant to the last decade of the twentieth century.

The objective of business process reengineering as explained by Davenport [8] is not to achieve incremental improvements of say, 5%, 10% or even 50%, but to achieve multiplicative levels of improvement, i.e., to obtain a return 10 times greater than before. The proposition is that new technology applied to a new organisational structure will produce these very high returns.

To achieve this sort of result is by no means easy. What is needed is a fresh look at the organisation not in terms of whether specific jobs or tasks can be improved but rather in terms of what processes are actually needed. In fact business process reengineering combines the adoption of a process view of the organisation with the application of innovation to the key processes. According to Davenport

> "What is new and distinctive about this combination is its enormous potential for helping any organisation achieve major reductions in process cost or time, or major improvements in quality, flexibility, service level, or other business objectives." [8]

There are numerous examples of dramatic improvements achieved through business process reengineering of which the following are but a few examples.

Federal Mogul reduces the time to develop a new part prototype from 20 weeks to 20 days. Mutual Benefit Life halved the costs associated with policy underwriting and insurance processing. The US Internal Revenue Services collects 30% more from delinquent tax payers while halving its staff and removing a third of its branches. IBM Credit reduces the time to prepare a quote for buying or leasing a computer from seven days to one, while increasing the number of quotes prepared tenfold.

There are several different drivers for business processing reengineering which include, the need to dispose of outdated rules and regulations which have outgrown their usefullness, the need to remove time from the business cycle and thus improve service and profit, the necessity find ways of supporting low cost strategies, the requirement to responding to customer pressure, and developing better coordination between functionally interdependent parts of the business. However as Davenport points out

> "Of the many operational reasons that private-sector organisations embark on process innovation initiatives, almost all can be traced to the need to improve financial performance." [8]

Nonetheless if only financial objectives are used as the basis of a business process reengineering programme they are not likely to inspire the same amount of effort as objectives such as improving customer care or ensuring that products get to the market before competitors.

However, business process reengineering is not the only road to change or innovation. Other authors argue [9] that business process reengineering may not be enough and that what is actually needed is a completely new change paradigm, i.e. a new way of thinking about our business existence, a new framework, a new modus operandi for achieving and sustaining individual and corporate success. Some business philosophers talk about this as being total business restructuring. Davenport [8] describes this as business innovation when he points out that ultimately business process reengineering needs to be implemented in terms of a radical review of the organisation which requires a reassessment not only of processes, but also of new work strategies leading to fundamental change in all the firms'

complex activities involving technology, people and structure. Davidow and Malone [9] argue that the radical change which is needed will be achieved through the concept of the virtual corporation and the virtual products which they will produce. These ideas are explored in more detail in section 8 of this paper.

Other writers take a stronger behavioural science point of view. In his book The Fifth Discipline, Peter Senge [37] address much the same issues but from primarily a systems and a behavioural point of view.

7 Business Restructuring

An interesting view of the change which is required in business in the mid-1990s is supplied in the ideas of Charles Handy [16]. Handy's ideas may be seen from several different points of view including personal development, business process reengineering and also business restructuring.

In his book Age of Unreason, Charles Handy offers a fairly comprehensive framework for working towards business change. To understand Handy's ideas it is useful to know that the title of this book is derived from an expression which he credits to George Bernard Shaw:

> "George Bernard Shaw once observed that all progress depends on the unreasonable man. His argument was that the reasonable man adapts himself to the world while the unreasonable persists in trying to adapt the world to himself, therefore for any change of consequence we must look to the unreasonable man, or, I must add to the unreasonable woman." [16]

Handy goes on to say that if we are to succeed in the Age of Unreason, and this is the age which Handy believes we are in, we need to master upside down thinking. The argument that we are in an age of unreason is based on the fact that we are currently facing a large number of discontinuities, and as a result, old approaches to people, development, management and organisations are no longer relevant. Upside down thinking is no more than just questioning every assumption on which we base our business thinking. Therefore we must seek out every opportunity for change. The issue of upside down thinking correlates highly with the ideas of Pascale and Foster in that upside down thinking is a vehicle by which corporate renewal is achieved. Upside down thinking also offers a practical modus operandi for finding business process reengineering opportunities. Practitioners of upside down thinking continually challenge all the assumptions which have historically made the organisation successful. This approach forces the organisation away from the complacency which is inherent in success and makes it amenable to discovering new paradigms for the future. Thus Handy is strongly in support of the view of Pascale and Foster.

Handy's thesis is that in this current period of discontinuity we will need to focus on change and on our ability to learn. Handy in fact sees the notion of changing as only another word for, or another way of talking about learning. He offers an extensive discussion on these issues but according to his view there are basically three broad groups of ideas on which the business should focus.

For the individual to succeed in the Age of Unreason he/she will have to acquire:

- A proper selfishness
- A way of reframing
- A negative capability

A proper selfishness essentially refers to individuals taking an interest in their own self development. It is a similar concept to what Senge [37] refers to as personal mastery. When this occurs the individual sees himself/herself as only being fulfilled when they are developed to take on more interesting challenges.

A way of reframing refers to the ability to ask upside down questions and to come up with new ways of looking at old situations. For example the question of whether an invoice is required is perhaps the first step in the upside down thinking which is needed in order to reengineer the accounts payable system.

A negative capability refers to being able to work in circumstances which are thoroughly unsatisfactory but at the same time being able to see beyond the negative aspect of the situation. It is a negative capability which allows individuals to struggle through unfavourable circumstances towards the goal of rectifying the situation. Having a negative capability requires individuals to have adequate faith in their own abilities to be able to take chances which are necessary to overcome present problems.

These of course are behavioural issues which have at their roots the notion of how people should be employed in the efficient and effective organisation.

However for the organisation to succeed, more than just individual people issues must be attended to. It will be necessary for the organisation to acquire a shamrock structure, grow a fourth leaf, practice subsidiarity, and develop inverted American do'nuts amongst others. All these ideas represent major innovation challenges, some of which may be accommodated within the framework of business process reengineering, while others extend beyond that relatively narrow view of innovation to total organisational restructuring.

The shamrock structure refers to organisations having three distinct sets of people available. The first set, or leaf of the shamrock, may be referred to as the core where full-time permanent staff will be employed. These individuals will posses the core competencies which the organisation requires to succeed. They will be highly committed individuals who will be with the organisation for a long term career. They will work hard for long hours and will be correspondingly highly rewarded. The second leaf of the shamrock refers to outsourcers. It is argued that only core competencies should be retained in the core [31] and everything else should be outsourced. According to Pearson

> "Core competencies are the basis of competitive advantage in achieving strategic intent. Acquiring and nurturing competencies that are not core is simply a waste of resources and effort and serves only to dissipate concentration. It is much better to buy in non-core competencies and focus all in-

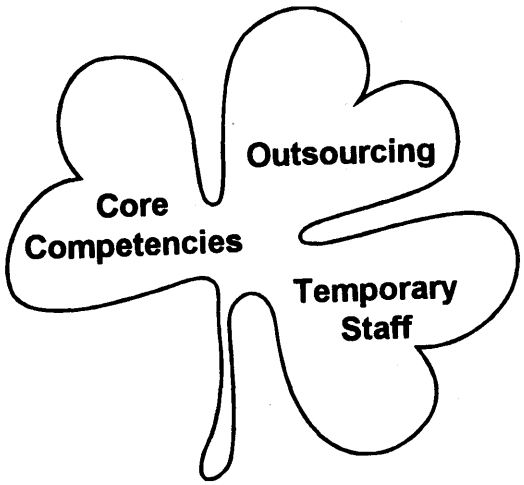

Figure 4. The three leaf approach to corporate structure

ternal efforts on the acquisition and development of what really matters." [31]

The third leaf of the shamrock describes the organisation's use of temporary outside people who are required only at the peeks of the business cycle and not as permanent members of staff. Figure 4 shows the three leaf or section corporate structure.

Handy extends the shamrock model by discussing the possibility of a fourth leaf. Of course shamrocks are three leafed weeds, and as such a fourth leaf does not exist. However, Handy asks his readers to imagine such a device. In the organisational analogy the fourth leaf represents the participation in the organisation by its clients. It is pointed out that earlier in the century banks assisted depositors by having tellers complete deposit slips for them. At some stage it was realised that the whole process would be substantially improved if the depositor completed the documentation before presenting it to the teller. Handy sees this as a fourth leaf. A more modern example is that of IKEA [28], the home furnishing retailer where the client is asked to actually participate in the production of the furniture by assembling it in the home after purchase. In addition, IKEA does not deliver, again asking the client to participate in this part of the traditional business process. The result of this, according to [28], is that IKEA can offer its products at between 25% and 50% more cheaply than competitors and this strategy has resulted in IKEA becoming the world's largest retailer of home furnishings.

Figure 5 shows the extension of the three section corporate structure to include the fourth leaf.

The ideas of subsidiarity and the American do'nut both focus on the issue of empowerment of the individual in the organisation.

Subsidiarity refers to organisations insisting that decisions should be made at the lowest competent level in the hierarchy. This ensures that individuals are given freedom to exercise their authority without excessive interference from their superiors. The concept is an old one having its roots in religious organisations and has recently been adopted by politicians in the discussion of the European Economic Community. This notion is absolutely necessary if the idea of individual empowerment as described by Senge [37] is to be made into a reality. The American do'nut is a metaphor used to contrast the individual's formal responsibilities, i.e. those which appear in the job description and informal responsibilities, or those which the individual takes on as he or she develops in the organisation. Handy's view is that there will be an increasing amount of informal responsibility which individuals will have to accept.

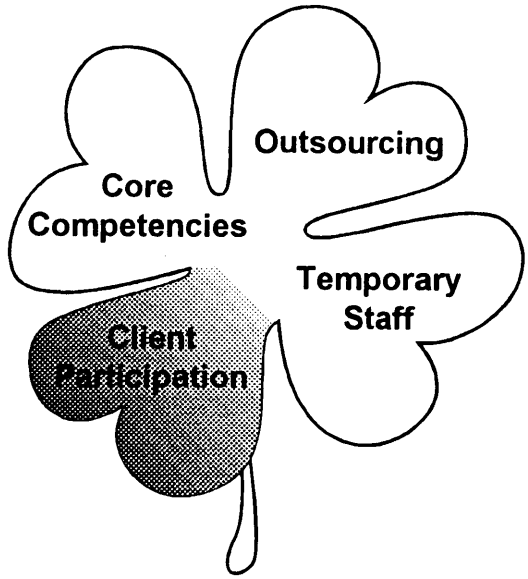

Figure 5. Inclusion of client participation in the corporate structure

Thus Handy offers a fairly comprehensive view of how an organisation could restructure itself to meet the new challenges where the old economic principles and structures no longer apply.

8 The Virtual Corporation

Another way of restructuring the organisation to cope with the current environment which focuses on products and processes is supplied by Davidow and Malone [9]. Their basic proposition is that whereas the past fifty years has seen a substantial amount of technological change, the next ten years will see a phenomenal amount of organisational and management innovation which will completely transform organisations as they are known today. A vision of the business organisation of the twenty-first century is now forming in which there will be a new organisational dynamic, a new corporate structure, a new manufacturing approach and office systems which will be substantially underpinned by the availability of innovative information technology.

Davidow and Malone refer to this new organisation as the virtual corporation largely because, through the use of data communications, it will extend beyond the boundaries of the traditional organisation (see Figure 6) and because it will eventually deal in what they refer to as virtual products. Their definition of a virtual product is one in which products are *"produced instantaneously and customised in response*

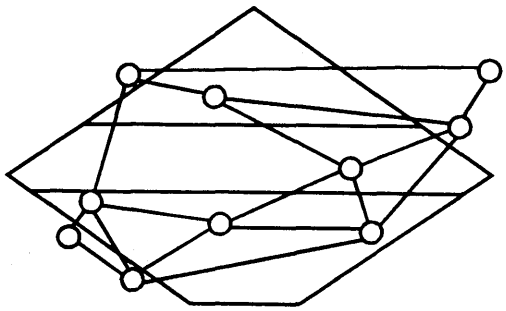

Figure 6. The new structure in a networked corporation

to customer demand."

Examples of virtual products include:

- Prescription eyeglasses ground and supplied with customised frames in sixty minutes.
- Colour film processing in 30 minutes.
- Car oil change in fifteen minutes.
- ATMs dispensing cash 24 hours per day world-wide.
- Instant world-wide airline reservations.
- Instant world-wide credit authorisation.
- Instantaneous news broadcasts from all parts of the world.
- Fast food vendors fulfilling orders in less than 20 seconds.
- Japanese automobile manufacturers delivering customised cars in under 72 hours.
- Japanese home builders providing customised dwellings in weeks.

Thus in terms of a strict definition of the word instantaneously, it may be seen that Davidow and Malone take some liberties. Nonetheless the point which they make is clear. The corporation of the future will be well served if it can produce cost-effective, mass-customised goods and services with as little delay as possible. This approach to production results in a greater ability to meet customer demand, higher productivity both in the office and the factory, and much lower inventory levels. In turn this allows the corporation to compete internationally and thus return to appropriate levels of profitability.

In some of the examples above improvement in performance is the result of the direct use of technology to achieve disintermediation. Disintermediation is the process of removing from the industry value chain steps which are either no longer adding value or are actually adding to the delay in bringing the product or service to the customer. In the 30 minute colour film processing example, this can be achieved because the customer takes the film directly to an outlet where the laboratory is based and there is no longer an agent such as a chemist shop between the customer and the processor. To achieve the delivery of customised cars in under 72 hours the purchaser has to be in direct contact with the database of the manufacturer and be able to place the order directly into the scheduling systems of the factory. From the outside the virtual corporation will appear relatively edgeless with multiple interfaces between company supplier and customers. Of course, this notion is not in itself new as it may be seen as an extension of the value chain concept [34] to embrace an industry sector rather than just one single firm or organisation on its own and has been the basis of supply chain management for quite some time. But Davidow and Malone call for a much higher level of co-operation, in fact commitment, between the firms in the industry value chain. This mode of co-operation is shown in Figure 7.

From the inside the firm will be entirely different with the traditional business functions either being blurred or being entirely replaced with business processes and a team approach to work. Thus business process re-engineering is a key route to achieving the benefits of the virtual corporation. In this new business form there will also be far fewer hierarchical levels which will assist the virtual corporation in being far more flexible and thus responsive to its clients and environment.

To achieve this new level of innovation the organisation will have to be reengineered, restructured or reinvented. However change for its own sake will not be sufficient. One of the most celebrated cases of change being missmanaged is that of General Motors. In the late 1980s and the early 1990s GM spent $77B at their Hamtrack plant on new plant and equipment including a large scale robotisation programme, where they had 260 robots for welding, assembling and painting cars. Unfortunately some errors were made in the implementation of the robots which resulted in robots designed to paint cars actually painting each other, robots designed to install windshields systematically smashing them instead, and robots smashing into cars and thus destroying both the cars and themselves.

The way forward to the virtual corporation is complex. It requires a new philosophical as well as practical approach to business. The virtual corporation requires the recognition of the fact that the organisation, its clients, its workers and suppliers, in fact all its stakeholders, share a co-destiny which for the twenty first century requires a much higher level of trust than was the case in the past. This trust is the key to all the stakeholders co-operating to produce products and services of the right quality, at the right time, at the right place and at the right price. The notion of co-destiny is quite novel to the industrial societies of the twentieth century where an adversarial attitude has generally prevailed. This approach has been well described by Pascale [29] when he pointed out,

> "While our technological advances have been tremendous and our formation of capital enormous, Western organisations run themselves in 1981 in much the same way as in 1940. There is still troublesome tension between boss and subordinate, and between the firm and the public good, broadly defined. There are still negative attitudes towards necessary collective efforts, notably towards meetings and activities with outside groups. We still esteem the tough, individualistic, and dominating U.S. leadership ideal that prevailed in the past."

It is clear that these adversarial attitudes have had a negative effect on the economic performance of organisations.

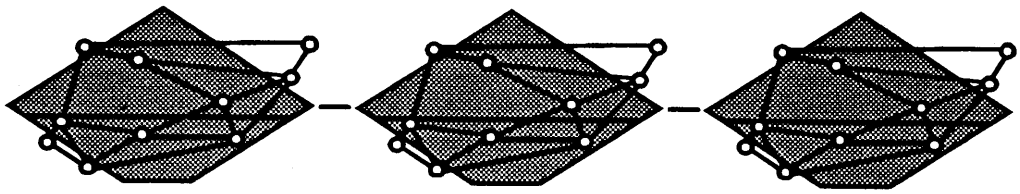

Figure 7. A networked value chain as a first step to a Virtual Corporation

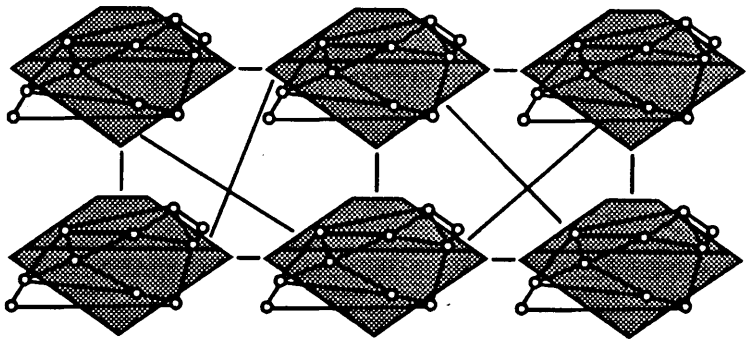

Figure 8. A network of virtual organisations

In achieving these objectives technology, and especially information technology, is a critical enabler primarily in that it allows time and distance to be shrunk. And of course it also allows information to be shared. But if the technology is used with the values of the twentieth century, which have frequently lead to adversarial relationships between the firm and its staff, the firm and its client or the firm and its suppliers it will be impossible to achieve the benefits of the virtual corporation. Physical reconstruction without the necessary adjustments to attitudes has been shown not to work.

The virtual corporation therefore will rely heavily on a new set of working relationships both outside and inside the firm. From an external point of view there will be many more collaborative networks and alliances, strategic and otherwise. These types of arrangements are illustrated in Figure 8.

Internal relationships will involve new circumstances in which the individual will be greatly empowered to do a much more comprehensive job than before. The old views of Adam Smith, FW Taylor and Henry Ford will have to be abandoned and new, more co-operative ideas will have to be employed. It is at this point that the ideas of Davidow and Malone, Handy and Senge begin to converge.

9 The Challenge of Change or Innovation

Although Handy, Davenport, Senge, Davidow and Malone are all reasonably well known, the ideas of innovation in the workplace as expressed in their books are certainly a long way from being universally accepted. The type of change or innovation which these authors propose is quite profound and business organisations, or for that matter any other types of organisation, generally do not respond rapidly to such a profound level of change. As John Locke [25] pointed out some three hundred years ago:

> "New opinions are always suspected, and usually opposed, without any other reason but because they are not already common."

In a more modern context, Handy [16] suggests that our main problem with regards to the implementation of these ideas is:

> "We are all the prisoners of our past. It is hard to think of things except in the way we have always thought of them. But that way solves no problems and seldom changes anything. It is certainly no way to deal with discontinuity. We must accustom ourselves to asking 'Why?' of what already is and 'Why not?' to any possible re-framing."

But there are probably many more difficulties facing those who would implement radical change in our organisations. Peter's discussion of the role of IT in organisations in the USA [32] points to the anti-intellectual climate which makes innovation or change so difficult today.

> "The public's lingering suspicion of "head work" is especially worrisome as the US becomes, like all developed countries, an almost totally brainbased economy, where information manipulation per se is the basis for advantage in every job and industry, old and new."

Unfortunately this suspicion of *head work* is not confined to the US but is a common attitude in many parts of the western world today and is a barrier to any change or innovation programme.

In fact how to manage the business affairs of organisations large and small as well as the performance of other not for profit organisations, effectively and efficiently is one of the great issues, and therefore research topics of the end of the twentieth century.

In fact in the light of the above literature it is possible to postulate the following theoretical conjectures.

1. The environment in which management exists today is truly complex and that the old management and business paradigms, which rely on division of labour and hierarchical command and control structures are no longer suitable to ensure top performance.
2. New management and business paradigms are required to successfully direct organisations in the mid-1990s.
3. Exhaustive or definitive paradigms or frameworks which will endure do not yet exist and are in fact unlikely to ever be found. Because

   > "There is an intrinsic impermanence in industry and indeed the management task is to recreate the company in a new form every year." [17]

4. What is mostly needed is a paradigm which will help managers cope with the endless search for finding new paradigms which will be relevant to the continually changing set of circumstances. Effectively this is a paradigm for paradigm changes.
5. Management need a substantial change in orientation away from looking for unique and non-changing solutions to corporate problems. This new outlook would allow them to pursue this challenge without feeling that they have been cursed in a similar way to Sisyphus1[1]

Furthermore as time goes on it is almost certain that current management principles will become increasingly irrelevant and thus lead to poorer and poorer results. To a large extent IT is forcing these new paradigms on management. Sherman [38] points out:

> "The democratic spread of information will force corporations, sometimes against their will, to depend less on command-and-control hierarchies and more on values that guide independent contributors towards furthering the corporate good."

Peters [32] also perceives the central role of information and especially the need for its democratisation as a way of promoting the new business paradigm:

> "Sharing information on a virtual real time basis and encouraging ...access to information in friendly forms which are helpful to many different users are essential. Functional barriers are effectively penetrated only when information about what is going on in other functions is made instantly available to people throughout the organisation. It is only through such a process that we can redress some of the old attitudes which have not contributed much to our organisational success."

In fact many observers [8, 15, 9] perceive information as a driver of the need to develop new management paradigms. However the author argues that information is more than a mere driver. Information has caused a basic infrastructure shift not only in the way things are done but more importantly in the way in which the world can be perceived and thus opportunities defined. As such it has opened up many opportunities which previously simply did not exist. However these opportunities have to be exploited by people who cannot be motivated or managed by the old paradigms. New management paradigms, largely related empowering and motivating people need to be developed and used if the opportunities which are now available are to be exploited.

[1] The gods had condemned Sisyphus to ceaslessly rolling a rock to the top of a mountain, whence the stone would fall back on its own weight. They had thought with some reason that there is no more dreadful punishment than futile and hopeless labour. [5]

10 Summary and Conclusion

Although information and its management is the main issue being referred to here it is most important to emphasise that IT itself is not the only issue. The view that IT is only an enabler of change is perhaps a misunderstanding as it does not emphasise how profoundly IT and the management of information has helped change the economic infrastructure in the past few decades. Nonetheless it is the innovation factor itself which is the key to improving performance in business and other organisations in the next few years. And this is not well appreciated even now. In fact one of the main problems faced today is that too much is expected from the technology itself, when at best technology is only part of the solution. As Zuboff [44] pointed out:

> "There is still this childhood belief that technology will make things perfect."

Our managerial problems are generally much more deeply rooted than just the performance of IT and require a reappraisal of the current paradigms at the deepest level. Therefore although the attacks on information management by Lincoln, Earl and others are undoubtedly well meaning, they are almost certainly misplaced. What is needed today is a way of re-examining or re-thinking, not the role of information in the firm or the organisation, but of the firm and the organisation itself. A fresh new mind set is required which will allow innovation to pay a more important role in management.

It is necessary to re-think all the economic and management assumptions on which businesses are based. It is essential to question the need for the bureaucracy and especially the hierarchical aspects of it. It is critical to consider how organisations can be redeveloped so that individuals can be more empowered. It is necessary to continually ask why would anyone do business with the firm as opposed to the competitors. It is essential to ask how would we want to be treated if we were the client of our own business. It is critical to perform this sort of analysis and evaluation on an on-going basis, as opposed to a once off basis. In fact what is required is the establishment of a process of continual analysis and evaluation.

Of course what is exceptionally clear is that education or perhaps more specifically, in the business context, training is key to any concerted effort to implement innovation in the work place, as only through these processes will it be possible to change the attitudes towards work, enterprise, clients, suppliers, analysis and evaluation. Education and training are absolutely vital to success. As Mark Twain [41] pointed out as much as one hundred years ago:

"Training is everything. The peach was once a bitter almond; a cauliflower is nothing but a cabbage with a college education."

Regrettably this is much easier said than done. Education and training at the required level is costly, time consuming and, perhaps most difficult of all, it is not by any means certain that there is consensus as to the sort of education and training which is actually necessary. What is really needed is a rethink of the highest order.

And of course classroom training is only part of the solution. The best education is definitely on the job where individuals can learn as they are empowered to develop themselves. This approach may constitute the best education as it is continuous perhaps for the rest of the life of the individual. Unfortunately it is often the most demanding and expensive type of training which many firms do not feel then can afford into today's economic climate.

The problems of information management which has been used in this chapter as the starting point in the discussion, are only part of the general difficulties which management is experiencing in many parts of the world, and in particular the West, in the mid-90s. These problems relate to deeply seated notions of not only how business is done, but how management in general motivates and controls organisations. There is no unique and permanent solution to any of these problems. Solutions are by their very nature transitory as they largely reflect the environment in which the organisation exists. Nonetheless there is a growing consensus that innovation in the work place is one of the main solutions to improving performance and thus organisations are encouraged to re-examine their processes and attitudes to find new ways forward to improved levels of performance. Many of these issues clearly extend beyond what was a traditional view of the scope information technology or even information management. However as organisations wrestle with their circumstances in the mid-1990s it has become essential to cast off traditional views and acquire new, innovation oriented mind sets to prosper or perhaps even to survive.

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Notes for Contributors

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 papers. 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. Figures should be submitted as original line drawings/printouts, and not photocopies.
- 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 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.

   Further instructions on how to reduce page charges can be obtained from the production editor.
3. In camera-ready format – a detailed page specification is available from the production editor;
4. In a typed form, suitable for scanning.

Charges

Charges per final page will be levied on papers accepted for publication. They will be scaled to reflect scanning, 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 for contributions in typed format (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 categories 2 and 4 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.

Camera-ready submissions will only be accepted if they are in strict accordance with the detailed guidelines. It is the responsibility of the authors to ensure that their submissions are error-free.

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.

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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).
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).
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