CHAPTER TWO

REVIEW OF RELATED LITERATURE

Introduction

The purpose of the study is to examine the impact of technology on a democratic political system in South Africa. The study investigates the relationship between technology, as a systematic application of knowledge to resources to produce goods and services, and democracy in South Africa's democratic political system. This chapter deals with the review and analysis of the literature relevant to this topic. The chapter provides three themes, which are the core of the theoretical background, of which the objective is to discuss technology in different perspectives where there is a major impact on the democratisation environment in a political system. The following themes are the key constructs: *the historical overview of the literature debates on technology policy; the democratisation process in South Africa; South Africa's technology policy; the democratic politics of technology,* and a summary to conclude the chapter.

The above key constructs in the study correspond with the divisions of works under review. They are central themes of the study and are clearly manifested in the formulation of the research problem. (Mouton 2001) The objective in this particular instance is to determine, through inductive reasoning, the definition and description of the key construct in the study. Each presents a broad context, then current variations and challenges, a review of selected literature, and finally a perspective relating to the hypothesis in this thesis. Each theme presents a set of premises pertaining to each construct in a democratic political system, broadly considered. Some of these find corroboration within other chapters, particularly in relation to the links between them as categories of analysis.

Literature that supports this study

This research is both interdisciplinary and integrative, and therefore draws on areas of study not usually considered connected. Drawing on literature from political sciences and extended analyses of technology means not all relevant studies could be covered. Areas of public administration and management are omitted. Rather than exhausting a narrow area of research, the intent here is to focus and examine broad areas in order to identify patterns that exist across the separate categories of analysis where in-depth analysis normally occurs. The deductive derivation of the research hypothesis suggests links between disciplines; it draws on sources, which are to be found relevant to the processes of technology policy formulation and governance in the South African democratic political system. Crow and Sarewitz (2000) see technology as a force that can transform social structures and create new phenomena. Because this study falls into the general category of a deductive goal, it realises the potential of technology to enhance the democratic political system. The provision of access to information and technology and instituting mechanisms for democratisation at all levels of society is a fundamental assumption of this thesis, and is supported by modernisation theories. Some of the literature below does not share this point of reference, being mostly concerned with non-critical contribution to political science. This is particularly evident in the business literature. Other areas, such as studies of media, technology and society, and in particular electronic governance, are overtly concerned with social outcomes. This study addresses the overlaps and gaps in these approaches in order to accumulate a perspective that is intended to be both a practical and a theoretical contribution. The relevant areas are outlined below, along with the additional perspective provided by the current research.

Themes of the literature review

The following themes are the key constructs in this literature review study. Firstly the chapter looks at *the historical overview of the literature debates on technology policy;* secondly at *the democratisation process in South Africa;* thirdly at *South Africa's technology policy,* and fourthly at *the democratic politics of technology. A summary of analysis* concludes the key constructs, which correspond with the divisions of the works under review.

A historical overview of the literature debate on technology policy

There has been more literature on technology policy approaches in the past two decades. The development of this literature started around the late 1960s and continued to the early 1980s, and focused mostly on the concept of "appropriate technology" or "intermediate technology" as it is commonly known. The concept first originated from the Neoclassical discussion on the "choice of technique", where many social scientists criticised developing countries for choosing the "overly capital-intensive" technologies in their import substitution industrialisation strategy and called for them to choose more labour-intensive technologies which were more suited to their own environment. The concept was subsequently adopted by a more radical school of thought in Schumacher's book "Small is Beautiful" (1973) and the Dependency theories. Both these schools argued that not only were the technologies imported from the advanced countries inappropriate for the local environment, they were also inappropriate for meeting the real consumption needs of the population. (Emmanuel, 1981).

From the late 1970s the debate moved to a more productive phase. Rather than debating at the general level whether imported technologies were appropriate or inappropriate, the debate was on why some countries were more successful in absorbing imported technologies than others. The consensus that emerged out of this debate was that, to some extent, developing countries needed some degree of technological capability if they were to be successful in choosing, adapting, and making incremental improvements of imported technologies. It was also emphasised that irreversible investments were often needed in building such technological capability and that policy actions had an important role to play in the process. (Fransman and King, 1984.) The crucial point in this particular instance is that technology needs to be assimilated in society. Imported technology needs to be invested and must be adapted to local conditions if the appropriate national productivity levels are to be achieved. Where productivity levels are high, other socio-economic imperatives are covered and the standard of living gets boosted.

From the 1980s the literature became more sophisticated. Rosenberg (1982), Nelson and Winter (1982), and Freeman (1982) opened new debates in the study of technology. They laid emphasis on the evolutionary nature of the advances in technology and the importance of institutional and political policy factors in the process. (Dosi et al.1988.) These developments culminated in the birth of the concept of "national systems of innovation" (NSI), which South Africa adopted as its policy approach (White Paper, 1996) and through which the institutional initiatives were undertaken by government in the establishment of the National Advisory Council on Innovation Act, no 55 of 1997 (NACI Act), the primary objective if which is to advise the Minister on issues of science and technology policy. The importance is based on the role of institutional factors, and particular emphasis was placed on the inter-relationship between the constituent parts of the institutional complex in the determination of technological progress. (Lundvall, 1992 and Nelson, 1993).

These two schools of thought differed in their solutions. The former strongly advocated small-scale industrialisation, while the latter also wanted capital-new theoretical developments. They influenced the literature on technology policy, producing a new breed of theoretically sophisticated and empirically well-grounded literature, of which the most updated synthesis is that of Lall and Teubal (1988).

Most authors assert that the world markets, especially in developing countries like South Africa, may fail to generate a socially desirable degree of technological progress and that it is only the type of political policies that may be necessary to resolve this problem.

At best this literature review's contribution can be related to two areas that have been relatively ignored in the existing South African literature, namely the political and the institutional aspects of technology policy design and implementation. Succinctly stated, whether a technology's design and its use are compatible with perpetuating democratic social relations. (Scolve, 1995)

It would be a gross injustice to state that authors who contributed to the debate on technology policy in South Africa have completely neglected these two aspects. However, it would not be too much of an overstatement to mention that most of other

literature reviewed was decided rather on the basis of some objective theory diffusion, with little attention to the political aspect of technology policy design and implementation. In the same breath it would also be wrong to say that institutional factors have been neglected in some literature, especially given the numerous writings on national systems of innovation. However, it would be fair to say that far more attention has been paid in the literature to the institutions related to knowledge generation. (White Paper, 1996).

The political aspects of technology policy in South Africa unfortunately lacked a relatively well-developed literature which this study could draw from. Most literature dwells on industrial technology, with technology policy considered as the subcomponent of political sciences.

Having drawn some literature from other developing countries with experience, which were more less in the same situation as South Africa, the earliest stage of the debate on industrial policy was prompted by the success of Japan in dealing with the industrial changes they made towards their technology policy. (Johnson (ed.) and Thompson, 1989.) Subsequent literature was also mostly concerned with industrial policy, for instance the debate that started in the mid-1980s and culminated in the debate surrounding the World Bank's "East Asian Miracle Report". (World Bank, 1993). The debate at this stage was not really fruitful for the purpose of this study as it focused on establishing the existence of industrial policy in East Asia, with little relevant lessons to draw for the South African experience. Most authors argued that little industrial policy existed in both South Africa and the East Asian countries (Shcultze, 1983 and Balassa, 1988), and that its execution was mainly involved in the technical process, without some political elements which would have been useful to compare and analyse with the South African democracy.

Literature on the scope of the democratisation process in South Africa

Since the 1994 elections in South Africa there has been interest in the progress and the extent of the democratisation process. There is now substantial literature on many

aspects of democracy in South Africa, aspects which include issues of national security, socio-economic development, poverty alleviation, etc. The review in this section provides an overview of the issues and answers of various authors and relates them to the above analysis of democracy in South Africa. Most debates on South Africa's democracy justify theories around liberal democracy and the continuation of concerns about democracy in general. MacKinley (2001) argues that the African National Congress (ANC) became the standard-bearer of liberal democracy in South Africa. Since coming to power in 1994 it has followed the liberal democratic formula of institutionalising the combination of individual rights and capitalist market economics. South Africa's smooth transition from apartheid to democracy (Williams 2000) also outlines neoliberalism. Williams also presents the major shifts in the ANC's economic policy and makes particular reference to the role that the neoliberal discourse played in delegitimising alternatives and stifling debate during the transition. Now integrated with the global offensive mounted by internationalised corporate and finance capital, liberal democracy has acquired the mantle of a necessary and natural political product of an equally necessary and natural economic order. (McKinley 2001.)

Other aspects of the South African democracy relate more to opportunities created by democracy. Some authors are pessimistic or critically ambivalent about South Africa's democracy, while others are relatively optimistic. Muthuien, Khoza and Magubane (2000) give a corresponding review on the democracy in South Africa. They have reviewed the institutional forms and capacities that underpin South Africa's democracy and argue that a new culture of participatory democratic governance has emerged short of addressing prevailing inequalities.

Literature on the South African technology policy challenges

Prevailing technology policy challenges are the same as the insurmountable challenges of social inequalities that still face the South African democratic government. Lamounier (2002) in Tulchin (2000) observed challenges that social inequality present to democratic governments around the world. One of the particular themes which he looked at is the effects of globalisation on the distribution of income and wealth within national frontiers; he also looked at the impact of inequality on the stability and the quality of democratic governance. He thus presented an analysis of the future of democracies as being able to redress social ills of the past. The latter is important for this part of the study as there is a direct link between the effects of globalisation and the advances of technology, and the relative ease with which these travel across national boundaries.

Technology has inevitable political and economic effects. There are empirical grounds, as suggested by most authors, that technology as propounded by the effects of globalisation has more effects that influence the economic performance of a country. This is because the flow of the intellectual phenomenon presents ideas across the border. The intellectual phenomenon is more significant than transporting goods and resources as potential for technology in a democratic political system. It is also more real than in economic and political life, and thus knowledge in this regard plays a vital role in determining technology policy imperatives. The challenges for the South African policy imperative are that it should not be mapped outside the dictates of the globalisation effects. Schimmiter points out that globalisation may not even exist in any material sense but if enough people believe that it is present and potent, it will produce a significant effect by anticipated reaction. (Schimmitter 1999)

The main conclusion that emerged from this literature debate was that, although the policy tools used, such as tariffs, subsidies, tax privileges, etc., were in many ways similar for most countries, there were important differences in the way they were designed and implemented. For example, the Small, Medium and Macro Enterprise (SMME) and the Black Economic Empowerment (BEE) industry policy protection in South Africa come with relatively clear performance targets, like market performance and the extent of advancement given the incentives and non-incentives to the non-

industry performers, which would be penalised in the allocation of related privileges. And what determined these differences were direct factors such as political intervention directed by the government that is willing and able to provide material support.

The study endeavours to develop an analysis of the political and the institutional aspects of technology policy in South Africa, using some of the insights from the industrial policy literature and a very limited literature from technology policy itself. This was not necessarily simply a re-interpretation of the existing literature discussions on these issues in the policy debate. The study does not only seek to provide a somewhat more fine distinction analysis of the political factors in the policy process than what is currently available, but also undertakes to develop a more institutionally-focused analysis of the impact of technology in a democratic political system, with specific reference to South Africa. Before doing that, however, one also needs to identify the main characteristics of technology policy, as these characteristics will affect the way in which a democratic political system functions.

There are generally two extreme opinions presented by different authors: some believe that technology is a boon to democracy, while others believe that it is destructive to democracy. In an effort to demystify the cyber-utopia and the neo-ludite view, most literature makes reference to the fact that both schools of thought are correct in some respect as the policy process is also resultant from the political effect of advances in technology. It defines the ranges of how government communicates with its citizens and how society communicates amongst itself in a nation state given the level of advancement. The impact of technology, and particularly of information and communication technology, is a reflection of the extent to which innovations can been explored, and also gives an indication of the inefficiencies in the political system, which can sometimes be presented as a threat to democracy. Tetty (2001) asserts that even if more people are getting a lot of information, this does not translate into a significant expansion in the numbers and categories of those who engage in, and hence influence, the direction of democratic politics in the country.

There are dominant reasons why some authors see technology as being a threat to democracy. It is, firstly, premised from the fact that global network technologies have

no boundaries, that they do not respect any boundaries and at times undermine the enforcement of the rule of law, which defines the essence of democracy in a democratic political system. Democracy makes good neighbours in an increasingly interconnected world; it has both the means and the motives to promote the democratic process abroad. (Talbott 1996.) For instance, the availability of information and communication technologies (ICT) is the ease with which one can create a public sphere in 'cyberspace' through the use of personal computers, modems and telephone lines, the new global communications which are being established. In most parts of the world different organisations are integrated into the webs of horizontal, non-hierarchical exchange, and have already proved themselves able to counter censorship and disinformation. Interest and pressure groups have to a larger extent made use of the new technologies to advance their course, for example "one of the important tools of the Zapatisa movement in southern Mexico has been the internet". The movement's leader, Subcomandante Marcos, carries a small computer, through which he has been able to communicate with the rest of the world in a form that is not easily controlled by the government. (Ferdinand, 2000.) In fact, individuals can even find a way on the Internet to send a message to the Subcomandante. Communication was vital because for the rebel movement to succeed, it needed involvement from oppressed people all over the world, not just from the Chiapas. (Lutz, 1999). Secondly, it is argued that technology is dominated by the English language and as such is seen as eroding cultural differences and giving preference to a new set of national commercialism and consumerism values that thrive on the net; despite the global network that may integrate different communities there is therefore a concern regarding the growth of transnational cultural industries, as well as liberalisation policies pursued by organisations like the World Trade Organisation, which may reinforce current patterns of cultural colonialism. Technological innovations are in fact the enormous growth of international trade, and very supportive, liberal, political climate has facilitated the rapid transnational proliferation of mass market, advertising and electronic entertainment produced by mega conglomerates. A uniform consumer lifestyle is being aggressively marketed across the globe. Thirdly, the private and privatising environment of the Internet in particular is seen as destroying national democratic values. Although the South African economy has distinct positive privatising features in its technology approach, it is also hampered by political uncertainty, poor productivity, an over-emphasis on the

exploitation of natural resources, and consumer-driven economic cycles. Hawkins (1992) maintains that, to achieve rapid growth, South Africa will have to transform its economy to become investment driven and export intensive, with the emphasis on manufacturing and services. Private sector alliances with foreign multinationals could provide South Africa with access to the technology and marketing skills it needs.

Southall (2000) alludes to the fact that South Africa's first universal suffrage election of 1994 inaugurated a transition from apartheid to democracy. Yet there are continuing debates about the quality of that democracy that promised a better life for all during those first elections. He is cautiously optimistic to note that, although South Africa faces several problems and long-term challenges that could easily erode its democratic potential, democracy is acquiring a basic strength. The transition, which transformed South Africa from a pariah nation into a progressive multicultural democracy, is identified as a model throughout Africa and a symbol of hope for struggling democratisation processes elsewhere. Jung and Shapiro (1995) have a worrying notion that there is a possibility that the South African democracy may lack some of the basic ingredients of a viable democracy due to the fact that the transition has been negotiated between the ANC and the apartheid government. The exploration and evaluation of the conjecture of the dynamics of democratisation presents challenges for the political system to concretise a democratic order.

South Africa's consolidation of democracy must be judged according to its own society's political involvement in the policy decisions and how it meets its achievement of social democratic vision. Under such provisions, South Africa is not a consolidated democracy but an emerging one; its transformation has been more political than economic. South Africa has witnessed considerable institutional and representational change, but certain behavioural and attitudinal elements continue to hinder its democratisation. Specifically, there is a technological divide in society, particularly between the rich and the poor, and the urban and rural communities. There is also a considerable allegation of corruption among the levels of government officials, which has lead to the disillusionment of the population. (Dreijmanis 2000.)

In an attempt to enhance democracy, the first democratically elected President of South Africa, Nelson Mandela, encouraged all the citizens of South Africa to take the

national project of accelerated and fundamental transformation of the country very seriously. He also encouraged the people to unite in a new patriotism in order to achieve the goal of creating a new society. He suggested some investment challenges that needed to be met, some new roles for local government, and some ways in which democracy could be promoted. Finally, he encouraged citizens to work together to make their country a winning nation. (Mandela 1996.)

The objective of this call was primarily the recognition of concerns about poor performance as regards the provision of socio-economic services in South Africa. Simkins (1996) maintains that South Africa's economic future depends on moving towards the conditions for cooperation, where all facets of the social services will be intertwined with the economic aspects. He had looked at the problems associated with the state's reconstruction efforts in terms of housing, health and education, the development context, taxes, spending, and poverty, and the move towards cooperation with business. He is doubtful whether, in the absence of political policy interventions, the delicate political balancing act required to achieve cooperation can be sustained long enough.

Currently different policies coexist in South Africa, for instance those that deal with individual human rights and with traditional communal obligations. Diverse political communities propagate different models of citizenship, even as citizens act out simultaneous membership in multiple groups. South Africans thus adhere ambiguously to conflicting notions of transformational society as is dictated by modernity and tradition, and economic needs. Society has to reconcile itself with those vestigial subjugations and disparities of privilege that continue to bother it. (Ramphele 2001.) The repercussion of these disparities in a diverse political community is also symbiotic to the technological divide which has been clearly documented as dividing society along the technological lines. Hence in an attempt to bridge the gap, South Africa has to recognise the importance thereof. President Mbeki, through the International Presidential Advisory Council on Information and Communication Technology, has taken wide initiatives to solicit advice in order to cover all elements of the information and communication technology sector in order to monitor rapid changes and keep track of the application, thus keeping pace with inevitable advances in technology and its applications. (ANC 2001.)

Technology policy in South Africa has been debated across a broad spectrum of society with vastly different interests. During the literature debate process it emerged that caution should be taken as the inherent power of technology application could lead to abuse in both government and society. For this reason Christianson (1990) presents an argument about certain inherent characteristics of technology which might be abused and with which a state may instil fear in its society and its neighbours. He specifically makes reference to nuclear power capability, which he says may undermine the public accountability of decision makers. He contends that there is a strong case for the demand that public policy decisions meet clearly defined criteria for rationality. He demonstrates that irrational policy decisions pose a distinctive threat to liberal democratic principles in South Africa; for instance, he says that nuclear power has been mooted as the answer to South Africa's long-term electricity requirements. However, nuclear power is controversial, and there is increasing awareness worldwide of both adverse environmental implications and its costliness. There are also other issues that demand careful consideration, and public policy decisions, such as the decision to launch a nuclear power programme, need to take account of clearly identified standards of accountability and rationality. Advanced technologies like nuclear power pose distinctive problems. These are discussed with specific reference to the nuclear option in South Africa. (Christianson, 1990).

There are some aspects of technology, especially information and communication technology (ICT), that present another level of power and control in a political system. Willett (1995) agrees that this level of power and accountability should be able to identify the beliefs, myths and values attending to the notion of democratic accountability. He asserts that this will show how the basis for the right to communicate should be established, as well as the strategies necessary for this right to be recognised, understood and accepted, and thereby legitimising the democratisation process. Challenges abound for ICT as an instrument to fast track a democratic process.

The South African Parliament also faces challenges that are posed by an increasing reliance on ICT; it has to have the ability to uphold the values and principles of an

inclusive participatory democracy for all South African citizens. The potential value to Parliament of harnessing increasingly sophisticated ICT vests in the ability of such technologies to play a critical role in facilitating co-operative governance and overcoming the information gap between itself and the majority of South African citizens. Consideration does however become important when there is an increasing dependency on such sophisticated technologies, which needs to be weighed up against the ability of Parliament to uphold, simultaneously, the democratic values of freedom and equality of access for the majority of citizens who may not have access to such sophisticated technologies. (Groenewald, 2000).

Despite all these technological efforts regarding socio-economic and political problems, South Africa has taken a courageous position with its adoption of a policy on the National System of Innovation (NSI) approach. Blake (1996) maintains that if an effective national system of innovation is the main approach of the policy, IT has to play a very central role in the realisation of that policy system. He further alludes that information and technology both enable and depend on a national system of innovation and that the IT industry in South Africa can be a major driver for the economy. He thinks that the information society makes great demands on human resources and that current deployment of IT is hampered by having far too few people with ability for innovation in IT.

Envisaged within the context of NSI is the new mode of production – centred on information technology and instantaneous worldwide electronic communication – which has become dominant in the era of transnational capitalism. There have been arguments around this topic; at the forefront is Louw (1995) who argues that if South Africa's potential is to be realised, the country will need to be fully integrated into the global electronic grid of information. If the challenge of a post-Fordist information economy is accepted, South Africa needs to concern itself with producing a population able to operate within an 'information economy'. This requires critical and aware media producers and users, which, in turn, requires a degree of coordination between media policy and education policy formulators. Contemporary cultural studies should grasp the opportunities offered by the flux of the post-apartheid reconstruction of society to demonstrate that a democratic political system can be built by co-opting the post-Fordist media technologies developed by multinational

capitalism. Louw's argument is also followed by Budlender (1995), who argues in his claim that by providing people with the capacity to use communications they will be able to make their demands more forcefully and successfully, testifying to a deeply urban-biased vision.

Literature on a theoretical construct of the democratic politics of technology

In the last years there has been a momentous continuation of victories in the world arena for liberty, human rights, and market economies. Historically these have been associated with democracy, thus democracy has emerged as a political system of choice around the globe. Within this democratic political system technologies have been exploited not only to enhance society's socio-economic conditions but also to enhance the democratic rule. The impact of technology upon lifestyles (Weeamantry 1993) that have been maintained for centuries, if not millennia, has been profound and widespread.

Tracing back to the genesis, a growing awareness of the problems at the interface between the expanding domain of technology and human rights prompted the General Assembly of the United Nations in 1975 to proclaim its Declaration on the Use of Scientific and Technological Progress in the Interest of Peace for the Benefit of Mankind (resolution 3384 (XXX) of 10 November 1975). This declaration called upon all states to take appropriate measures to prevent the use of scientific and technological developments to limit or interfere with the enjoyment of human rights and fundamental freedoms of the individual as enshrined in the Universal Declaration of Human Rights, the International Conventions on Human Rights and other relevant international documents. The same Declaration called upon all states to cooperate in the establishment, strengthening the development of the scientific and technological capacity of developing countries with a view to accelerating the realisation of the social and economic rights of the people of those countries.

In his book Democracy and Technology, Sclove (1995) presents a "disdain from the epistemological inanity of value free technology and the reductionist fallacy of technological determinism". He argues that misunderstanding about technologies enhances their relative structural significance, because it enables technologies to exert

their influence with only limited awareness of how, or even that they do. It is given that technology constitutes an influential social structure. He considers how this particular structure relates to the traditional question of democratic theory. What he ponders is the optimal size of a democratic community, the minimal standards of an informed citizenry, and whether communitarian/cooperative technologies would provide alternatives to today's monstrous business enterprises and public bureaucracies

Sclove (1995) has been brave to confront the possibility of conducting elections through the Internet; he does alternatively give unqualified endorsement to the popular notion that "virtual communities" might one day replace territorially defined states as the predominant locus of democratic politics. The apparent anarchy of the Internet is plainly at odds with the emerging hegemony of corporate control over cyberspace; the outcome of the struggle is as yet unclear. He provides clear illustrations of political and economic alternatives to social gigantism that give practical expression to the belief that technologically alternatives mediated tyranny, while a clear and present danger is not our necessary fate. From cooperative networks of small manufacturing firms to the non-profit centre for technology, democracy and technology are replete with practical illustrations of innovations, which permit the democratisation of technology in small and medium scale context. If this is less than a prophecy of a techno-democratic utopia, so much the better.
With regard to the hegemonic institutions of transitional business and the state, he maintains that "at a minimum they too should be reorganised into federations of quasi-autonomous, democratic divisions and subsidiaries". He is realistic enough to acknowledge that, although some decentralisation is taking place under the sway of strategic planning initiatives and reengineering programmes, any claim that a more democratic ethos is accompanying such organisational restructuring is at best premature. The summary in the Sclove literature is that it is possible to evolve societies in which people live with greater freedom, exert greater influence on their circumstance, and experience greater dignity, self-esteem, purpose and wellbeing.

It is said that the 21st century has promising scientific and technological innovations that were previously regarded as fictitious. Developments in nanotechnology, microelectromechanical systems (MEMS), genetic engineering, cloning, robotics, and

optical and quantum computing are likely to have a great impact upon the future structure of the society. While there is wide dispute as to whether these advances will be a boon or bane to humanity, there is a consensus opinion that change is coming. Joy (2000) sees a future that is frightfully bleak. He maintains that "accustomed to living with almost routine scientific breakthroughs, we have yet to come to terms with the fact that the most compelling 21st century technologies – robotics, genetic, engineering, and nanotechnology – pose a different threat than the technologies that have come before". He warns that society has become enamoured with the quest for scientific knowledge, that it no longer bothers to consider the impacts of the societal discoveries. Moreover, he is concerned that the self-replicating abilities of novel innovations in genetic engineering, robotics, and nanotechnologies (GNR) could produce dire results, including the end of humanity.

In the light of this potential danger, Joy suggests a controversial solution: verifiable, voluntary relinquishment of dangerous GNR technologies. He writes that "this requires vigilance and personal responsibility by those who would work on both NBC (nuclear, biological, and chemical weapons) and GNR technologies to avoid implementing weapons of mass destruction and knowledge-enabled mass destruction".

Joy (2000)'s sentiments are rebutted by Brown and Duguid (2000). They use the "ballyhoo associated with the dawning of the nuclear age in the 1950s to make their case", by referring to the fact that techno enthusiasts had previously predicted the "end of power monopolies, the emergence of the 'electronic cottage', the death of the city and the decline of the corporation". They both believe that much of Joy's pessimism stems from a tunnel vision that leaves people out of a picture and focuses on technology in splendid isolation. Brown and Duguid hold that the future is only profoundly bleak if one looks at it through the "6D" lenses of: demassification, decentralisation, disintermediation, despecialisation, disaggregation and demarketisation.

Dertouzos (2000) is also critical and troubled by the notion that human logic can anticipate the effects of intended or unintended acts, and the more arrogant notion that human reasoning can determine the course of the universe. He counters that society in

its ability to assess consequences can rely on its humanity, feeling and beliefs when determining the impact of technology. Unlike Joy, who would prohibit certain types of research because of their potential dangers, Dertouzos states that "we should instead proceed, but stay vigilant, ready to stop, when danger is imminent, using our full humanity to make that determination".

Crow and Sarewitz (2000) both see technology and innovations as forces that can re-make social structures and create new phenomena, which in turn lead to new institutions and response mechanisms. They believe that nanotechnology has the potential to be another catalyst for sweeping societal change. Their point is not to predict the future of nanotechnology and its impact but to illustrate the direction and scale of thinking that will be necessary if we are to successfully manage the interaction of new knowledge and innovation with society. They warn that the revolution is coming; that we can allow ourselves to be caught by surprise or we can prepare for it in order to enhance the benefit and reduce the disruption and dislocation that must accompany any revolution.

Nowadays it is clear to everyone that there is this problem of technology. It can be argued that no other comparably larger theoretical issue impinges so directly on daily life as does this problem in its various aspects.

It therefore follows that there is an adequate confrontation or reckoning with this issue in its full theoretical dimensions. For the most part this problem comes to light only as the problems of specific technologies. Is it moral and desirable for biological engineering to alter natural species? For example, who has the right to decide whether a foetus should be aborted or a patient disconnected from life-support machines? How are we to deal with the potential dangers of environmental degradation or nuclear war? Different technologies bring different problems, but beneath this apparent variety three practical questions seem to be raised by every advance in shaman power: Is it moral and desirable to do what this new capacity enables us to do? On whom devolves the right to decide this question? And how does one control the unanticipated or unintended consequences that may emerge from the exercise of this power? These are the problems arising from the development of a particular new technology, posed as a difficulty that is usually treated as a technical problem or as

policy questions to be resolved within the context of established moral and legal practice.

Not far beneath the surface of these practical issues, however, hang theoretical questions about the rational coherence, the psychological impact and the moral propriety of technology. The question can be asked if modern scientific rationalism can give an adequate account of the world, and especially of the human world, including the human capacity for science. Is the vision of nature and of man that imposes on society compatible with a truly human life, and does the technological project for the mastery of nature not violate some sacred or perhaps salutary limit on human power established by nature? These questions always cloud the existing policy debates. While escaping their direct attention, they constitute the problem of technology in a deeper and more interesting sense that guides the inquiry.

Amongst the critics of technology, Heidegger stands outside and against liberal democracy, which he sees as merely a political manifestation of technological rationalism. He views liberal politics and technological science from when it began to emerge at about the same time when it sprouted from premises concerning the autonomy of practical and theoretical reason to scriptural or technological absolutes. Critics of technology like him were nourished by shared hopes for humanity's progressive self-improvement through its conquest of political and natural worlds. Crow and Sarewitz (2000) also support each other symbiotically; they see liberalism protecting free and public scientific inquiry, with the latter having generated the technological and economic growth on which the former has depended. Because of this intimate connection, it seems peculiarly difficult for thinkers working within the liberal democratic tradition to confront the problem of technology in its most radical form, as the relative silence on this topic by liberal theorists John Rawls, Ronald Dworkin and Robert Nozick would seem to indicate. But for the same reason it is above all necessary for liberals to address it. The problem of technology is, to a very great extent, the problem of liberal democracy.

A general tone is set by Kass (1993) in specifying problems of technology, and by thinking about its possible implications for liberal democracy. He worries about technology because it provokes anew the age-old question of human happiness at the

same time that it tends to undercut the validity of such questions and endangers society's capacity to lead good and happy lives. According to him, liberal democrats must rediscover the richer, non-technological conception of liberty and dignity, if they are to keep their moral bearings in modern age.

Bimber (2001) asserts that some aspects of democracy appear more sensitive than others to the availability throughout society of political information. Individual-level political engagement poses a puzzle in this regard. An instrumental-quantitative conception of information central to rational theories and also found in some behavioural theories of participation, appears contradicted by historical trends. He alludes that contemporary expansion in political information is made possible by new information technology. He presents a model of the relationship between information availability and political engagement, based on survey data of Internet use between 1996 and 1999. The presentation is relevant to the debate whether the information revolution will prove salutary for participation, and at the same time sheds light on contending theories of information. His finding reveals that little relationship exists; the only form of participation demonstrably connected to Internet use is donating money. This finding fails to support instrumental conceptions of information and instead endorses cognitive conceptions employed in psychological and certain behavioural theories of political engagement.

Miller (2001) maintains that what moderns call technology is essential to liberal democracy, for without the increase of wealth, knowledge and opportunity that technology provides, the ruling majority could not be an enlightened middle class. Nevertheless, critics point to advancing technology's harmful side, with some hope to prevent these harms by tight controls. Others despair that technology lies beyond our control. In a neglected 1858/59 lecture and related speeches, Abraham Lincoln grappled with these issues and their implications for democratic statecraft. Although convinced that "discoveries and inventions" had rescued humankind from savage beginnings, produced abundance, and put genuine democracy within reach, Lincoln recognised that advancing technology alone would not guarantee freedom, but might bring new forms of mastery. Lincolnian statecraft seeks to moderate or limit this advance, not through stringent controls but by a moral teaching that builds on the natural right to oneself and includes a comprehensive doctrine of labour.

The effects of new information and communication technologies (ICTs) on democratic political systems in industrial societies have also been investigated by Chambat (2000), who in his study describes early adoption of ICTs by political institutions, e.g. computerised polling and voting, and evaluates the benefits and drawbacks. Preliminary evidence suggests that ICTs have not been that successful in improving political participation; the reaction of citizens to "teledemocracy" are not what has been said about the hype of technology. Looking at the machinery of government, he concurs that ICTs have been adopted successfully, improving public administration, decision-making, and information management. The role of ICTs in the public space is better off in terms of how it impacts on individuals in a society, the social communication network, mass media use and political function, and community cohesion. Contrary to Chambat, Slaton and Becker in their arguments assert that modern representative democracy was neither intended nor designed to function as a democracy, and progress in the past 200 years has come from the persistence of citizens operating outside established hierarchical power structures (Slaton and Becker 2000). A transformation of modern representative democracy is under way, and information and communication technology (ICT) is a key component in the evolution of more participatory democratic governments. The failings of modern representative democracy are highlighted by the decline in voting turnout rates and a high level of dissatisfaction with and distrust of elected political leaders. While advances in technology and the expansion and availability of information can hinder and harm efforts to advance democracy, a balance is sought to the discourse by emphasizing the potentials and benefits and by seeking solutions to problems in the representative systems. This is approached through the examination of four areas of enormous innovation and experimentation in utilizing ICT to develop new forms of greater citizen participation within representative democracy and for creating more effective direct democracy: voting from home, scientific deliberative polling, electronic town meetings, and direct democracy activities. The main conclusion is that ICT has aided forces that favour a stronger influence by citizens in representative government, which is already in the process of being transformed as nations move toward the global economy and citizens insist on more self-governance.

Stevenson (2000) seeks to tie in arguments that can be connected to the development of a global media culture and concerns around cosmopolitan forms of democracy. This is done by considering arguments for firstly a global human rights initiative in respect of global media conglomerates; secondly technological change in respect of digital cultures; and lastly the arrival of what Castells has described as the culture of "real virtuality." These views and perspectives are assessed in terms of the contributions they are likely to make towards what he calls a "cautious cosmopolitanism". He seeks to make some definite policy reference that helps foster conditions in which cosmopolitan democracy flourishes.

Cherny and Kapkov (2000) present an analysis of the rapid and dramatic changes in the politics and economics of the world during the twentieth century, and reveal that the role of science and high technology becomes extremely important for international development, security, and cooperation. The consequences of fundamental research become critical for mankind, and they determine and define preventive security. International scientific and technological cooperation, coupled with the financial power of the dollar, will make it possible to avoid an "end of history" or a "clash of civilizations", as well as to resolve many world conflicts. The importance that science and technology holds for the future of humanity must be added to the current definition of "democracy".

Catinat and Vedel (2000) contend that public intervention is the key to fulfilment of the promise of digital democracy. He describes liberal and digital democracy by alluding to an argument for government empowerment of digital information dissemination referring to economic, contextual, marketing, and subjectivity issues. Policy considerations are listed, such as privacy protection and access to infrastructure, public information, and services. Details are included of the cultural, educational, and sexual composition of Internet users. There is an examination of international gaps in technological access and changes in information-access policies. Exemplification of ways in which public actions may promote digital democracy includes specific methods for providing information and elucidation of laws concerning public access to data. Also considered are pivotal actions in the liberalisation and sponsorship of telecommunications. A government role in

promoting public awareness and enthusiasm for computer use, system design promotion, and organisation is important.

Barber (1999) argues that there are at least three scenarios for the future relationship of technology and democracy: (1) the Pangloss scenario, which is rooted in complacency and is simply a projection of current attitudes and trends; (2) the Pandora scenario, which looks at the worst possible case in terms of the inherent dangers of technological determinism; and (3) the Jeffersonian scenario, which seeks out the affirmative uses of new technology to nurture modern democratic life. He concludes that uses of technology that will nurture strong democracy require hard and imaginative work for which the political will appears to be lacking.
As in previous cases, Sclove (1995) argues that, insofar as citizens ought to be empowered to participate in shaping their society's basic circumstances and technologies profoundly affect and partly constitute those circumstances, it follows that technological design and practice should be democratised. He presents his argument in three parts. Part I synthesises two disparate bodies of knowledge. One is a corpus of recent research into the social dimensions of technology. The other is that body of knowledge and practice known as democratic theory. Part II develops a provisional system of design criteria for distinguishing technologies that are compatible with democracy from those that are not. Part III elaborates on the concept of the democratic politics of technology. Challenging the foundations of modern economic thought, the author argues that the democratic theory of technology qualifies as a coherent alternative to neoclassical welfare economics. Indeed, reinvigorated democratic politics should largely supersede conventional economic reasoning as a basis for technological decisions.

Hager (1993) revisited the developments in Germany that during the past two decades the mobilisation of grassroots citizen groups has posed a fundamental challenge to institutional politics. One important, often-overlooked aspect of this challenge is the relationship of democratising movements to technology. Grassroots protest arose mainly in reaction to large, state-sponsored technological projects. Citizen movements reopened the question of the citizen's proper role in technological decision-making, which had long been part of theoretical discourse. Grassroots activists challenged not only policy decisions but also the legitimacy of the bureaucratic institutions that

produced those decisions. Informed political participation has raised the technical competence of policy in Germany, while eroding the legitimacy of traditional policy-making institutions. Citizen groups have since directed their efforts toward developing alternative political forms that will reconcile technical competence and participatory democracy. The theories of Claus Offe and Jurgen Habermas illuminate the legitimation problems that lead to citizen protest.

Weinberg (1990) considers two questions: Do the two technologies that represent the highest engineering achievements of this democratic age (nuclear energy and the microchip manifested in instant communication and precise control) threaten the stability and freedom of liberal democracies? Can technologies that pose risks, but are regarded by many experts as necessary for survival, survive democracy? In short, the author asks whether modern technology and democracy can coexist

Summary of the literature review and analysis

Challenges in the political, social and the economic milieu prompted the review of the literature, which demonstrated that technology could have an influence over a democratic political system. It is evident that technology can shape the military and the economic environment of the political system. It is also clear that technology as a systematic application of knowledge to resources can provide a good tool for sustaining democracy in South Africa.

The important question that was addressed is whether technologies are substantively democratic, and whether technology policy decisions are compatible with perpetuating a democratic political system. The review investigated and appraised democratic theories and analysed approaches and challenges in democratic politics of technology, which could be applied in South Africa. Specifically the focus was the character and crisis in technology, and also the theoretical and practical resources that are available for democratisation in South Africa.

In essence, if democracy is impacted by technology, as systematic application of knowledge to resources to produce goods and services, it also enhances stability and

equality. Therefore, it can shape challenges in the environment of a democratic political system by maintaining stability; it will also deliver material prosperity, and foster democratic rule in society.