

MILLENIAL MEGATRENDS: FORCES SHAPING THE 21ST CENTURY

by

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INTRODUCTION

Mr Chairman, ladies and gentlemen

I wish to thank the organizing committee for the invitation to address your conference on the subject of “megatrends” - ie, all embracing societal forces of change that are shaping our future. You will appreciate that the rationale underlying “megatrends” is very complex because of its systemic nature; it implies some understanding of the interwoven processes which constitute the fabric of long-term societal change. It is therefore only possible for me to present you here with a few outlines - simplifications, or models - of the complex forces that are changing global society.

Within this context I see my task as, firstly, to identify and discuss a few of the most important historical change levers (ie, the historical factors which initiated broad-based societal change) and, secondly, to describe the nature and consequences of the societal changes that followed. If I am presenting the case within a somewhat deterministic mould it is only done to reinforce the key message that modern change is technology driven.

In this spirit of extreme simplification my presentation will centre on two periods, namely a period of 200 years which spans an “age”, and a period of 50 years which spans a technological “wave”. Our focus will primarily be on the past 200 years since the start of the “Industrial age”. However, for the purpose of comparison it may also be useful to focus briefly on the two 200 year periods which preceded the industrial age (see Figure 1), namely the Renaissance (broadly speaking ca 1375 to ca 1575) and the age of enlightenment (broadly speaking ca 1575 to ca 1775).

The term *Renaissance* means literally “rebirth”, and was for the first time used by the French historian Jules Michelet to describe the period of approximately 200 years between the late 14th century and late 16th century when the fragmented feudal society of the Middle Ages, with its church dominated social order, was transformed into a society in which central political institutions, an urban commercial economy and lay patronage of education, arts and

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music became the norm. The study of history (with contributions by authors such as Leonardo Bruni and Niccolo Machiavelli) became a branch of literature rather than of theology. The *Renaissance* started in Italy and spread to the rest of Europe during the 16th century. An almost symbolic invention of this age was the Gutenberg press, which was named after its inventor Johann Gutenberg of Mainz in Germany. The explosion in the printing of books and position papers which followed this innovation initiated the first “information revolution”; one which *inter alia* contributed towards the Reformation and, in general, towards the rapid diffusion of new ideas and scientific theories throughout Europe.

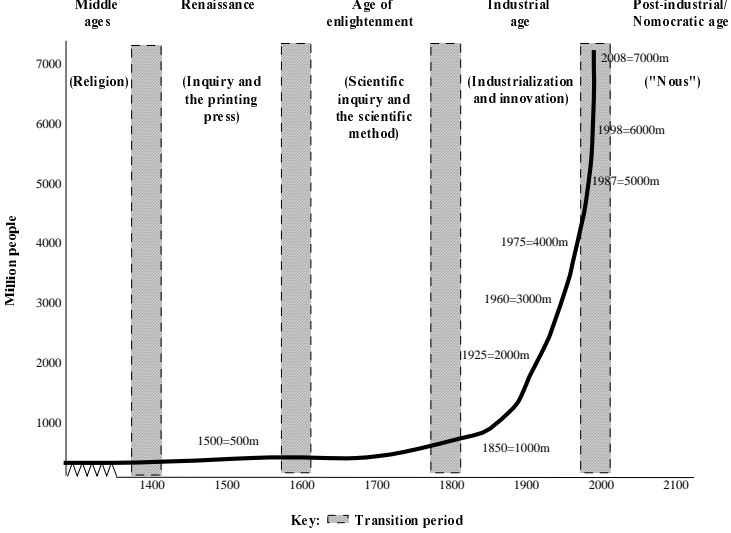


Figure 1: Five “ages”: Building towards the 21st century

The concept “enlightenment” refers normally to the emergence in 18th century France of progressive and liberal ideas that later contributed towards the French Revolution. My concept of an “age of enlightenment” refers to the emergence in the late 16th century Europe of a new scientific tradition which was stimulated by the contributions of earlier *Renaissance* scholars such as Galileo, Kepler and Copernicus. The scholar who opened the door towards a scientific revolution was, however, Francis Bacon because he was the forerunner of the British empiricist tradition. Sir Isaac Newton (17th century) and Rene Descartes (18th century) are the other two scholars who are often linked to the concept of scientific reductionism - ie, the methodology which forms the basis of modern scientific inquiry. It is argued in this paper that the scientific discoveries of the age of enlightenment prepared the ground for the industrial age.

A VERY FLAT EARTH

Changing times

Exactly 200 years ago Thomas Robert Malthus published an essay *On the principle of population as it affects the future improvement of society* (Malthus, 1826). England was entering the early stages of what later became known as “the industrial revolution”. This “revolution” would profoundly alter its production systems, economy and social order within the span of 50 years. Far more manufactured goods were being produced than ever before, while technical efficiencies increased dramatically from one decade to another. This was achieved by the systematic application of scientific and practical knowledge to manufacturing,

by a process of capital accumulation and by the growth of corporate enterprises. Large agglomerations (or clusters) of these enterprises developed rapidly within a few urban concentrations of industrial activity.

There was as a consequence a steady migration to the cities by thousands of rural people who were enticed by the prospect of new opportunities in these industrial growth centres. It was the beginning of a new “modern” age of innovation-driven changes and capital-based wealth creation; changes which liberated people from the confines of a specific station in life within a semi-feudal society. However, they soon faced an equally severe new dispensation, namely the class-based stratification of the new industrial society. The migrating *gemeinschaft*-oriented rural communities were suddenly confronted with the severe realities of the *gesellschaft* (contractually) stratified society in the industrializing cities (Tonnie, 1955).

A dismal future

The conditions of poverty, squalor and social degradation in the squatter camps and ghettos of early industrial England must have shocked Malthus. He postulated an emerging survival crisis for a population which, according to him, was increasing at a *geometric* rate, when the natural resources which must sustain it were increasing at only an *arithmetic* progression. These *arithmetic* increases in the natural resource base was assumed to be correlated with, firstly, the fuller exploitation of existing natural resources and, secondly, with the “discovery” of new productive regions. It was a period of territorial expansion and colonization, with the European countries - and Britain in particular - acquiring more and more real estate around the globe. But the globe sets also the limit to this expansion; ie, it confronts the “constant tendency in all animal life (which include human life) to increase beyond the nourishment prepared for it” (Malthus, 1826:2). Thus Malthus’ prognosis of ultimate disaster unless there is “moral restraint” (or abstinence) in human procreation.

Malthus’ view on the rate of population growth at the time was certainly not without foundation. The global population reached a figure of 500 million people around the time Columbus discovered the Americas (ca 1500). It was at the start of an age of knowledge explosion; the so-called “scientific revolution”. The foundation of the modern analytical scientific method was prepared, and new competencies in a number of areas of human enterprise - such as in agriculture, medicine and manufacturing - were developed. Trade and the general level of economic activity expanded rapidly, as also the quality of life for many. As a consequence rapid population growth became a notable factor of this post-*Renaissance* period, and the global population doubled within 350 years to 1 000 million - ie, by ca 1850 (McHale, 1972). This was approximately 14 years after the death of Malthus, and 52 years after he wrote his essay on population.

A futurist living around the end of the 18th century could therefore confidently select Malthus’ model as a basic framework for a prognosis of the future of mankind. It must have been “clear” to all thinking individuals of the time that disaster is looming. In terms of the best knowledge of the times there was a very real prospect that population growth would bump against the ceiling of resource availability sometime during the 19th century.

Through the looking glass

Disasters did occur, but more in the shape of human conflict and wars about issues not directly related to an impending natural resource crisis. These emerged rather in the form of the assertiveness of the new industrial powers who wanted to use their new-found wealth and technological-industrial capacities to enforce their designs over regions and populations. The Victorian-era created a “Great” Britain - an empire over which the sun never sets. “God” was an Englishman, however, a number of other “gods” were emerging in Europe, in the Americas and in the Far East. Such a world is bound to experience a “battle of the gods”. This at first found expression in the form of a number of expansionary wars, and ultimately in a slow but persistent build-up of a new intense ideological conflict which was reflected in the intensification of discord between capitalism and socialism, and between the conflicting designs of nations who gained new political leverage from rapid industrial growth - thus upsetting the balance of power. One can therefore say that the great wars of the 20th century - ie, World War I, World War II and the Cold War - were the logical extensions of the technology-driven power shifts which occurred during the 19th century.

And what phenomenal innovations did occur in the world during the 19th century! The groundwork was prepared by innovations in steam power and the use of coal in iron production during the late 18th century. It took off with the application of steam power to transport and textile manufacturing. In the 70 years following the development of Stephenson’s “Rocket” locomotive in the 1820s, and the introduction of rail transport in 1830 with the opening of the Liverpool-Manchester railway, the world saw a flood of ground breaking innovations such as the introduction of telegraph networks, electricity, the telephone, the internal combustion engine (including the Diesel engine), the motorcar and a large number of other innovations which metamorphosed established socio-economic practices, and life in general. Exponential growth became an accepted norm of performance, with only the rate of growth being in dispute. Even more important, the main source of economic and political power shifted irrevocably from the control of natural resources to the control of capital.

As a consequence, the industrializing world experienced a social, cultural and economic revolution during the 19th century which was at least as momentous and disruptive in its general scope and characteristics, as that of the transformations over the whole of the post-*Renaissance* period between the end of the 15th century and the end of the 18th century. In other words, the world for the first time in recorded history started to experience accelerated change. One of the best indicators of this is the explosion in the global population which occurred over the past 150 years. Within 75 years from 1850, ie, by 1925, the global population increased to 2 000 million. The 3 000 million mark was reached 35 years later, in 1960, the 4 000 million mark 15 years later in 1975, the 5 000 billion mark 12 years later in 1987, and the 6 000 millionth person was born in this year - ie, an increase of 1 000 million people within 11 years (McHale, 1972; *Population Newsletter*, No 62, 1996).

The moral of Malthus

What is the moral of Malthus for futurists? Not that Malthus was wrong as such in the approach he followed in formulating his prognosis. As was already explained, he correctly observed a disturbing increase in the rate of population growth, and the governing perceptions of the time regarding the real basis of human sustenance would have convinced any 19th century analyst that Malthus presented a very plausible prognosis of the future of mankind. Malthus was without doubt a very unique and courageous thinker for his time. However, he also suffered from a very common human blind spot in perception, ie, an inability to foresee the inter-linking consequences of rapid technological change, and the long-term implications of the shifting circumstances of his time. The moral of Malthus' story can be expressed in the following way: *When confronted with momentous changes we all tend to become "flat earth" people; we tend to formulate our view of a future "reality" on the basis of our current view and understanding of the world.*

CHARACTERISTICS OF TECHNOLOGICAL CHANGE

The primary driver of long-term change

Technological innovation is the primary driver of long-term change in society through its creation of meaningful new capacities for human achievement (Marchetti, 1981). Once a meaningful innovation is introduced into society it sets into motion a chain reaction of initiating impulses which, *inter alia*

- produces an autonomous (self reinforcing) capacity for improvement in a particular technology;
- continuously develops new fields of application for a particular technology;
- develops associated clusters of complimentary and supplementary technology, which in turn set in motion their own chain of reactions of other developments;
- creates new products, markets and industries - and destroys the old ones as the old technology, which previously supported them, nears the end of its life cycle;
- creates new professions and skills - and destroys the old ones;
- creates new power basis and power relationships within society;
- changes life styles, cultures, values and, in general, the accepted norms of society;
- increases the reach between man's power to do good things and to do evil things;
- creates the problem of growing complexity in the management of human affairs - for example environmental problems, the problem to cope with the consequences of new technological developments such as human cloning, and the problems of social degradation, corruption and alienation because a growing number of marginalized people in the so-called "Third World" find it impossible to cope with the changes they are being confronted with .

The essence of technology

Technological innovation is therefore not just a process of artifact improvement (eg, replacing Pentium I processors in computers with Pentium II processors), but implies a general improvement in the *system of competencies* within which a new technological artifact is applied. This *system of competencies* flows through the machines, procedures and processes that are used in human enterprise, the system of knowledge (or paradigm) of a society, the organizations and institutions that serve society, the industries which generate the wealth, and the state of development of a society in general.

This view of the nature of technological progress centres on a definite perception of the nature of technology - namely, the perception that it is “embodied knowledge” and not just a collection of artifacts. The word technology comes from the Greek *techne* which means skill or art, and *logos* which refers to the structure and principles of reasoning and sound thinking. Therefore, at a more practical level, we can define technology as a system of interdependent competencies which amplify human ability through the rational application of skills in the solution of practical problems.

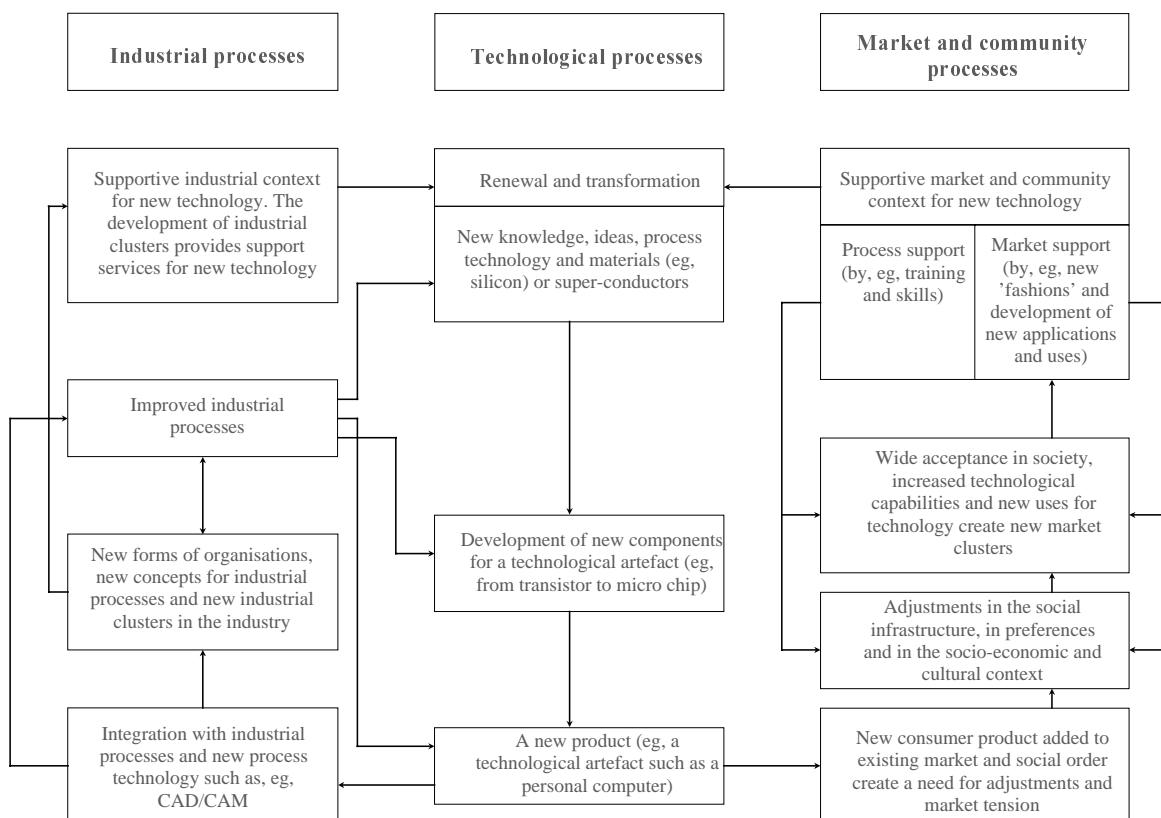


Figure 2: The strengthening cycles which spur on technological innovation

From this definition one can distill the following notable qualities of technological progress as we experience it today, namely:

- It is centred in the mental capacity and skills of individuals, and in the knowledge base of society - ie, not in some superior collection of machines and artifacts.
- Its sustainability is dependent on continuous and well balanced human and institutional development.
- It is driven by three mutually reinforcing processes (see Figure 2), namely, industrial development, science and technology development and economic development (which translates into market development).

The MEI-evolutionary progression

The pattern of technological transformation tends to follow a *MEI-evolutionary progression* over the very long term - which underpins the so-called “ages” - and a *life cycle*, which maps the emergence, rise and decline of a particular technology.

The notion of technological evolution is analogous to that of biology; artifacts being to technology what organisms are to biology. The *MEI-evolution* refers to a shift in the dominant orientation of technology from the manipulation of Matter, to the manipulation of Energy, to the manipulation of Information (Van Wyk, 1984). The *MEI-evolution* process shaped and transformed the ages of man - not only in terms of the general characteristics of productive activities in a particular age, but also in terms of the nature of its society, its power relations and mode of operation (see Figure 3). For example, during the pre-industrial age productive activities were focused mainly on the manipulation and transport of physical things (matter), mostly by using various kinds of tools and devices which were human and animal driven. The basis of wealth and power was control over land and land resources, which by implication means that a rural gentry tended to dominate the political and social scene.

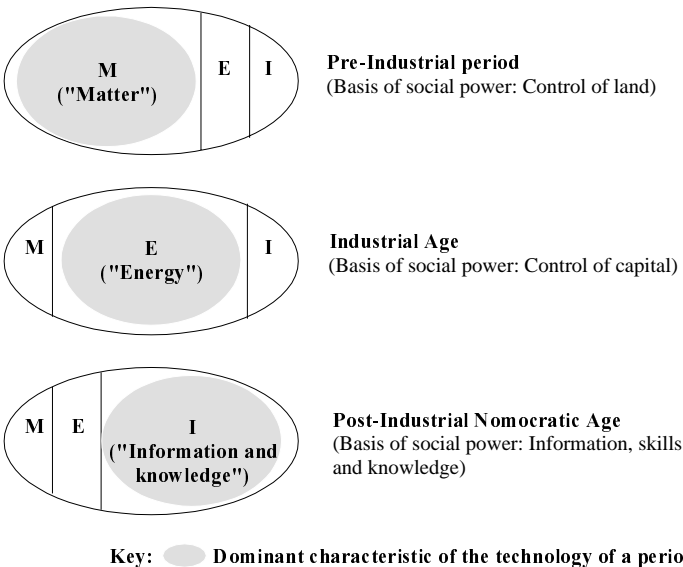


Figure 3: The shifting emphasis of the dominant technology of a period: The MEI technological evolution

The industrial age differed from the pre-industrial period in that it introduced the use of inanimate energy (E) on a large scale in a process of mechanization. In other words, the tools and devices became machines powered by coal, petroleum, electricity and other forms of

energy. The basis of wealth and power shifted to capital, which translated into a slow but persistent shift in power away from the formerly powerful rural aristocracy to an urban-based capitalist elite; an elite which also includes the labour union institutions and political movements with a strong support base in the union movement. An associated characteristic of the industrial age is the increased strategic interest of the industrial powers in securing control of the energy and mineral resources that are needed for their industrial growth process.

A number of authors hypothesized that we entered a postindustrial age sometime between the middle of 1970s to the early 1980s, ie, approximately 200 years after the industrial age emerged. The main distinguishing characteristic of this emerging age is the growing importance of knowledge and information systems in everyday life, and particularly in economic progress (see Figure 4). Within the context of manufacturing one observes a growth in automation; machines have become automata. Within the context of organizations one observes, firstly, a systematic increase in the scope and complexity in applications of information systems, and secondly, a slow but persistent shift in the locus of organizational power from the capital/labour axis to those individuals with the necessary skills and knowledge.

AGE IN HISTORY	MODE OF PRODUCTION	NATURE OF SOCIAL POWER
Middle Ages (until 14 th century)	Agriculture and artisans	Church and landed gentry
Renaissance (until 16 th century)	Commerce, agriculture and artisans	Merchants, city states and landed gentry
Age of Enlightenment (until 18 th Century)	Commerce, agriculture, artisans and small manufacturing	Merchants, landed gentry, nation states
Industrial Age (until 20 th Century)	Manufacturing	Capital, labour in nation states
Post-industrial Nomocratic Age	Services and networking	Embodied “capital” (knowledge, skills and information in global society)

Figure 4: The shifting emphasis of social structures and processes during the second millennium

Therefore, while the information age is creating incredible new capacities to communicate and interact, a new powershift is once again occurring. Control over land and capital is becoming progressively less important, and the mastery of knowledge and information systems more important. Moreover, in this new world order the role of the skilled and trained individual as the “holder” of the new empowering resource of knowledge generation becomes ever more important, while the individual as manpower resource becomes ever less important. As a consequence, this new world order spells a widening gap between the “haves” (of knowledge, skills and information access) and the “have-nots”. A few more observations on these issues are presented later in this paper.

The technological life cycle

As was mentioned previously, the life cycle maps the emergence, rise and decline of a particular technology such as railroads or steamships (Modis, 1992:55-72). Technological development normally follows an S-shaped pattern which indicates an early stage of emergence (as the technology is established), a stage of rapid growth (as the technology becomes institutionalized within society), and a stage of maturity and decline when the traditional market of a technology starts to decline as it becomes infested with new innovations which differ qualitatively from the older one (see Figures 5 and 6).

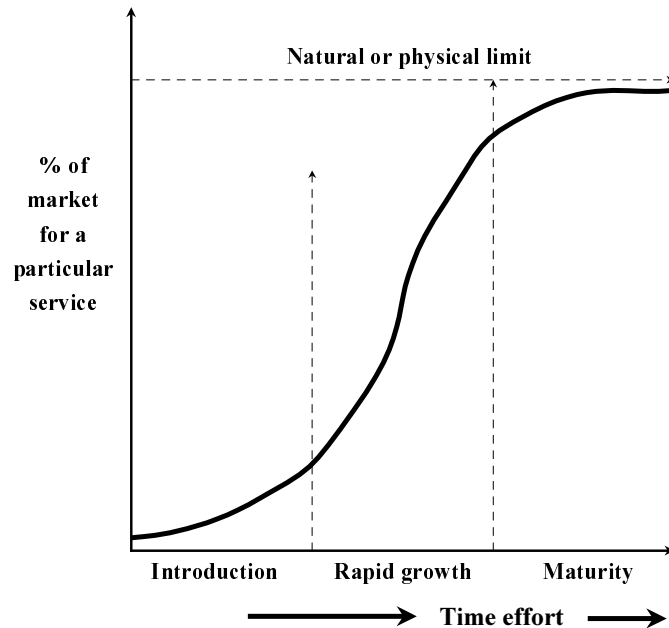


Figure 5: The S-curve of technological development

Figure 6: Competition between transport infrastructure expressed as a percentage of the total length of all transport infrastructure in use in the United States in a particular year

Source: Modis, T. 1992. Based on the work of Nakicenovic, N. 1988. Dynamics and replacement of US transport infrastructure. In Ausubel, JH & Herman, R (Eds). 1988. *Cities and their vital systems, infrastructure past, present and future*. Washington DC: National Academy Press.

We differentiate between smaller shifts in the market place when new “models” of a particular technology replace the older ones, and the introduction of a new empowering technology which initiate groundshifts in the social order. For example, General Motors’ innovation during the 1920s was to produce cars which differ fundamentally in design and colour from Henry Ford’s black Model-T Ford. By doing so they opened a new direction in motoring, and succeeded to destroy the market for Model-T Fords. Model shifts have a short-term cyclical impact on socio-economic development. In contrast, the impact of a new empowering technology can be considerable. It tends to rewrite the rules of socio-economic development, producing in the process clusters of development and new industries, which in turn set in motion a wave of innovation and economic growth.

The phenomenon of long cycles in economic activity was described by the Austrian economist Joseph Schumpeter as “a gale of creative destruction” (Schumpeter, 1947:81-86) following a 50 year cyclical pattern. Schumpeter was fascinated by earlier observations by Jevons (in 1884), by the Dutch economist J van Gelderen (in 1913), and the Russian economist ND Kondratieff (in 1926) - who is perhaps the best known through the popularization of the “Kondratieff long cycle” (see Ayres, 1990, Part I:1-3). More recent studies by J Forrester - who applied systems dynamics modeling to the study of industrial growth processes, also indicated the existence of a long wave of approximately 50 years in duration (Forrester, 1976).

WAVES OF CHANGE: THE FOUR MAJOR TRANSFORMATIONS OF THE INDUSTRIAL AGE

More recent research into the implications of technological innovation have identified four definite technology-based long-term cycles of innovation, growth and stagnation over the past 200 years - ie, over the period that was earlier described as the “industrial age” (Marchetti, 1981; Ayres, 1990; Modis, 1992; Linstone & Mitroff, 1994). These seem to substantiate the earlier findings of Jevons, Van Gelderen, Kondratieff and Schumpeter. The following overview presents a summary of some of the most salient characteristics of the four innovation waves (or quarters) of the industrial age, as discussed in the works of Ayres, Modis and Linstone & Mitroff. For the purpose of simplification the industrial age is identified as the 200 year period between the 1770s and the 1970s.

The First Wave, the 1770s to the 1830s - Coal, iron and cotton textiles

The first transformation towards the industrial age occurred in the last quarter of the 18th century, ie, a shift away from the industrializing nations’ dependence on charcoal and water-power to the large scale use of coal for energy. This required a quantum leap in the capacity for mass transport in these rapidly developing economies, which was initially met by the building of vast networks of canals which linked the major rivers of industrializing nations such as Britain. The canals were primarily used for the transport of coal, and were extremely profitable for a period of 50 years - ie, until the 1830s.

The steam engine gradually made coal-based energy available as a rotational motion, which increased the scope of the application of coal power, both spatially and functionally. As a

consequence this stimulated a need for improvement in the materials that were used to build steam engines, and also created vast improvements in manufacturing capacity for all kinds of goods. Two other major innovations during the last two decades of the 18th century coincided with the switch to coal during this period, namely an important new textile material, cotton, and a new structural material, wrought iron. These two products became progressively cheaper and more widely available (Ayres, 1990:3).

Improvements in iron technology, in steam engine design and in machine tool technology, made coal-fired energy widely available as the primary source of rotational power for manufacturing. At first stationary coal-powered machinery supplemented water power to drive factory machinery, and finally they replaced water power. Then mobile coal-powered engines started to supplement horse and wind power. The widespread application (or diffusion) of steam power in transport was the key that opened the second technological transformation of the industrial age: It produced railroad transport. By the 1830s rail transport became technologically and commercially viable, and the monopoly of the canal system on the transport of heavy materials was broken. It initiated a rapid decline in the profitability of the canal systems, which in turn resulted in heavy losses in nominal wealth for the holders of canal shares between 1838 and 1843.

The Second Wave, the 1830s to the 1880s - Railroads and steamships

The advent of rail transport resulted in a massive construction boom in industrializing nations such as Britain - which was a significant factor in the recovery of that nation's economy after the recession of the early 1840s. Railway construction also provided a strong impetus for the expansion of iron production, the development of better iron making technology (such as the hot blast technique) and, ultimately, the development of steel. Railways also triggered the creation of telegraph networks. Moreover, the availability of efficient transport infrastructure, and the development of coking technology, stimulated the innovation of gas-lighting in the second half of the 19th century.

The powerful impact of the railway on middle 19th century Europe is best illustrated by the 1838 comments of Friedrich List, who was at the time a consul for the United States of America in Germany. He wrote the following (Ebeling, 1995:14-15):

“In order to foresee the full effect of such developments, imagine that every country and every noteworthy city in Europe is linked by railways and steam boats, and that services are so regular and such improvements and savings are made in transport operations over the next 25 years that it is possible to reduce the transport charges. Moreover, consider that the average speed of travel will soon be 37 to 45 kms. per hour, and that one will therefore easily be able to cover 450 to 562 kms. on summer days. If we were to examine each social class in turn, we would be astonished at the influence such a transport system must necessarily have on improving the situation and productive capacities of each and every individual. The doctor, the solicitor, the scholar, the artist will henceforth be able to extend their sphere of activity to distant cities and countries. A great actor, for

example, will be able to appear on stage in Berlin today, Hamburg tomorrow, and Hannover the day after tomorrow. A Saxon manufacturer who hears of new discoveries in his field in Paris and in London, will be able to visit these capital cities for a modest sum and will only require 5 to 6 days at most for the whole trip. A new invention is all the more important and beneficial the more it affects the well-being and education of the working classes. According to this yardstick the railways are the greatest invention of ancient and modern times; they are true engines of public welfare and education.”

The Third Wave, the 1880s to the 1930s - Steel, petroleum, the motorcar and electricity

The third wave of change started with the emergence of the petroleum industry, the substitution of steel for iron as an engineering material (being itself a spin-off from the railway's increasing need for more resilient metallic products), and the innovation of electricity and the internal combustion engine. These innovations, and also developments in the gas-light industry, provided the initial feedstock on which the rapid development of the chemical industries was based. Moreover, the growth in the use of textiles resulted in an increased demand for dyes, soaps and bleaches, and a growing demand for illuminating oil created a refining industry. These developments helped to stimulate innovations which led to development of the internal combustion engine.

Just as in the case with coal, iron and cotton in the 18th century, these developments also had a immense stimulatory impact on the economies of the industrializing nations. It resulted in a spurt of new infrastructure development. This overlapped with the tail-end of railroad construction which peaked around the second to third decades of the 20th century. A combination of the innovation of electricity, of the telephone and of the motorcar created vast new growth industries, and transformed the life styles of millions of people in the industrialized world. A synergism between road networks and telephone networks - and the development of mass road transport services - allowed for a dramatic decrease in inventories as from the 1920s (Ayres, 1990:4). Clusters of other and associated innovations during the late 19th century include, *inter alia*, deep freezing, artificial fertilizers, sewing machines, bicycles, photography, moving pictures, the first electrical appliances, etc.

As was mentioned earlier, the increased rate and reach of industrialization not only changed the shape of society, but also the shape of societal and political power in the industrialized world. New “gods” appeared on the international scene, thumping their breasts while staking out new claims on territorial hegemony. During 1914 this transformed into the 20th century's first cataclysmic event, ie, the four year long World War I. Despite the huge losses in economic infrastructure and human life, this so-called “great war” also produced important technological spin-offs, such as new aircraft technology and heavy road transport technology, as well as new approaches towards large systems management. World War I represented an important turning point for industrialization as a socio-economic process. It established the terms of reference for a new global order where industrial power reigns supreme - ie, the struggle for the control over capital representing the real struggle for power in society. By the

1920s the world had changed, figuratively speaking, into a “machine” (Mumford, 1990), with various sectors of global society interacting with each other in a vast network of political, economic and societal interdependencies. By the end of the 1920s this “machine” came unstuck in a “great depression” which contributed towards the second cataclysmic event of this century, World War II. It also sounded the end of the third wave of the industrial age, and opened the path towards a fourth wave of innovations.

The Fourth Wave, the 1930s to the 1980s - Pent-up consumer demand, aircraft, materials technology and electronics

According to Ayers (1990:5-6) the great depression, followed by World War II, resulted in vast accumulation of savings and pent-up consumer demand. This pushed the postwar period of sales expansion, involving much the same goods and services which fueled economic growth during the last phase of the of third wave of the industrial age. However, some of the first signs of the coming “nomocratic” world (where knowledge generation becomes the basis of power) appeared on the horizon. There was a slowdown in the demand for steel, which was roughly compensated by an increased demand for aluminium and plastics. A large number of new chemicals, and processes to produce them, appeared on the market. New detergents, synthetic materials, synfuels, synthetic rubber, polyesters, acrylics, polyethylene, and many other creations of the human mind, flooded onto the market place. This was an early indicator of the now well established trend which points towards a decline in the relative importance of basic materials and minerals as a proportion of total manufacturing value added.

A second area of development during the fourth wave of innovations was that of electronics. Building on discoveries such as that of Maxwell (in 1860), Hertz (in 1887), and Marconi (in 1896) - and other developments such as the vacuum tube biode early in the 20th century - the electronics industry took off with a vengeance after World War II. The radio and television industry, and the associated services, expanded rapidly and became a powerful feature of the daily life of people around the world. But these developments pale into insignificance when compared to the growing dominance of computer technology - especially after the innovations in solid state electronics since the 1960s. It can rightfully be claimed that the development of the high speed electronic computer was the key towards a large number of associated innovations in space technology, new developments in materials technology and biotechnology in the 1970s.

A third area of innovation of the fourth wave was in the field of air transport. Again, building on developments that had already started early in the 20th century, air transport rapidly developed a dominance in the market for mass passenger transport since the 1960s - cutting into the markets of the passenger train, long haul bus services and the passenger ocean liner. Within the short period of two decades since the 1950s the global passenger transport scene changed radically, and the world was suddenly much smaller. Together with the innovation of electronic media and the growth of computer networks, this prepared the stage for the emergence of the global citizen in an ever shrinking postindustrial world.

THE POSTINDUSTRIAL AGE: TOWARDS A NOMOCRATIC WORLD

Let us now return to the hypothesis, presented earlier in this paper, that the world entered a postindustrial information age sometime between the late 1970s and the early 1980s. The word “postindustrial” first appeared in print in 1917 (Nelson, 1996:479). However, the first comprehensive review of the concept appeared in *The Coming of the Postindustrial Society* by Daniel Bell which was published in 1973 (Bell, 1973). According to Bell the economy of this new society will be marked by a change from a goods producing economy to a service economy. Socially it will be marked by the pre-eminence of a professionally and technically skilled class, and in decision-making by the creation of new kinds of “intellectual technology”. Other related concepts which also appeared in print are “information society” (Naisbitt, 1984), “service society” and “knowledge society” (Drucker, 1969).

Another description of an emerging postindustrial world is that of Kostoupolos (1988) who refers to a “nomocratic society” where knowledge is not the servant of the people but in fact the master. “Intelligence” is, according to Kostoupolos, its specific “labour force”. It incorporates (and integrates) human cognitive qualities, artificial intelligence, stored knowledge and information networks. He argues that knowledge would be the “axis” of a future (postindustrial) nomocracy, just as landed estates represented the “axis” of the pre-industrial world, and capital that of the industrial world.

Others, such as Senge (1990) and Marchetti (1981) write about “learning” organizations and “learning” societies. The essence of such societies and organizations is the need to remain competitive (in order to survive) in a world dominated by high rates of innovation. There is therefore a need for continuous improvement and renewal.

A few trends pointing towards the emerging knowledge and information based postindustrial world

Under the heading “Information Society” Ruben Nelson (1996) presents a few interesting pointers towards a changing scene and its possible implications:

- In 1954 only 20 computers were shipped to customers, and only 160 computers were in use in Europe in 1958. In contrast, by the early 1990s 140 million computers were in use worldwide and 400 million microprocessors were imbedded in motorcars, telephones, televisions, and in a number of other appliances. By 1994 the Internet had over 30 million users worldwide, and this figure is growing rapidly.
- In the mid-1950s, approximately 80 percent of the cost of a new motorcar represented wages and materials. The cost of services and information accounted for the rest. By the mid-1980s these ratios were reversed, ie, 80 percent for services and information.
- By 1991 computer hardware and software exports from the United States amounted to R250 billion, which was more than double the value of motorcar exports.
- One can now add to these trends the now well known statistic of a doubling in the computing capacity of computer technology every two years

Nelson points towards a few important implications of the onset of a knowledge based world order, namely:

- The need for a new epistemological foundation - a new understanding of what knowledge is, how it is created, how it is validated and what its economic role is in an age based on the concept of knowledge and information (ie, in the same way as there was an understanding of the role of land in the pre-industrial world, and of capital in the industrial world).
- A challenge to put knowledge to practical use - which refers to a growing threat of being drowned in a sea of useless knowledge (or educating the unemployable).
- A growing preoccupation with the formulation of subcultures for self-critical learning and self-monitored performance - which represents a return to the concept of community (but this time around within the context of *nous*), emphasizing the need for learning as an enculturalization process.
- A growing difficulty of effective governance as unconvinced minorities undercut majority decisions because they are progressively better informed, and have the ability to utilize informal networks and the media

New rules of the game

It should be obvious that a new knowledge- and information-based world order will be based on different premises and rules for the effective management of organizations and societies. A few pointers towards the likely nature of this shift are presented without defending the particular position, ie, it is suggested that the coming information and knowledge-based world order means:

- A systematic shift from machine and organismic based organizational forms which are centrally directed, towards team based participative organizations in which the individual plays a pivotal role (Ackoff, 1994).
- At the level of national governance, a shift from representative democracy towards participative democracy.
- The demise of centralist institutions (structured around specific value chains) which emerged during the industrial age, with a growing emphasis on organizational learning and adaptability - and thus the decentralization of services and management structures (Evans & Wurster, 1997).
- A growing need for effective global governance (but not more global control) through improved information flows and communication.
- A need for continuous improvement in the access to effective knowledge and information - especially of importance for the survival and development of the less developed parts of the world.
- A growing need for a fresh approach towards the management of complexity - such as, for example, applications of social systems sciences in problem solving.

- A growing need for the exchange of ideas, skills, knowledge and information, locally and globally, and the emergence of a global *noitic market* (after the Greek *nous*, for mind).
- A relative decline in the power of the nation state because progressively more of the state's economic powers will be affected by the global integration of the international capital market, by electronic transfers dominating international capital flows, by the international electronic media and communication systems, by the “global factory” and “global market place”, and thus by the growing need for international competitiveness - which in turn sets the specifications for the most appropriate (or globally acceptable) social and economic order for a country (Ohmae, 1995).

CONCLUSION

This paper argued that the world is today entering a new age which will, in all likelihood, be as different from the industrial age as the industrial age was from the pre-industrial period. What the ultimate nature of this new world order will be is still unclear - in many ways we are again “flat earth people”. We can only detect the outlines of the patterns of change that we are facing. Therefore, like Malthus, we are running the risk of building our scenarios of the future around extrapolations of our current perspectives and experiences, while we should also consider the full (interlinking) implications of the trend breaks and groundshifts that are certainly to follow with the coming of a “noitic age”.

What we do know, however, is that the quality of our management of global affairs over the next 20 to 30 years will determine our success in gaining the most from the exciting promises offered by a knowledge and information driven world order. This much we can learn from our experiences over, especially, the past century. The industrial age produced great wealth, and even welfare, for the industrial nations. However, it also produced a number of serious imbalances and inequities in the world - imbalances and inequities which threaten to destroy all the good things that flowed from global industrialization. For example, the full benefits of 200 years of technological innovation were enjoyed by only one quarter of the global population. More in particular, it would be important to find solutions to the following four vexed problems of global governance:

- Given current trends, the global population is expected to increase from 6 billion to 10 billion within 50 years, while at least 90 percent of the additional 4 billion people will have to subsist in severe poverty, not being able to enjoy the fruits of the coming dispensation (unless something is done about their situation, which will, in turn, have a positive effect on the prognosis of unbalanced population growth).
- The global environmental threat is something that will remain with the coming generation for a period of at least another 50 years - that is even with the shift towards a post-industrial world order and growing environmentalism in the world - because of the current imbalances in the global distribution of economic development and wealth, with a real possibility of rapid increases in air, water and land pollution as the share of the economic wealth of the new industrializing regions increases.

- There is a growing threat of political imbalances in the now rapidly developing “Third World” - ie, the kind of imbalances experienced in the industrialized world over the past century - and this may well become the most important threat to global security over the next 50 years when regional “demi-gods” start to flex their new-found muscles.
- There is a growing threat of “scientism” as human ability to make shattering new discoveries outstrips the wisdom to apply this new knowledge wisely - a threat which is compounded by growing fragmentation in the process of scientific inquiry, and especially the seemingly growing divide between the humanities and natural sciences.
- A lack of understanding of the nature and workings of complexity (Cilliers, 1995) may well be our undoing when society and nature rebounds in unexpected ways, producing new kinds of social pathologies and new mutants of old diseases or environmental problems - mutants and problems for which we may find no effective cures and solutions.

Hopefully a post-industrial “noitic age” could offer the solutions for these potentially disastrous trends because of the increasing effectiveness of knowledge and information-systems. Human beings function according to their perceptions, which will hopefully be affected by a better insight and understanding of the important implications of these issues.

The shift in the basis of organizational power towards “embodied wealth” - ie, a shift towards skills and the competencies of the individuals in the organizations - holds another important message for the “merchants” of knowledge and information. The mode of transferring wealth in this coming “age” will not be through the transfer of capital or funds, but through the distribution of information, knowledge and skills to the less fortunate sections of society. Similar to the industrial age (capitalist/socialist) debate on the control over capital, one should, therefore, also expect a new and intense debate around the concept of social equity in the access to information, knowledge and learning (the “noitic market”) within society - globally and locally. Relevance and effectiveness will be the key standards of performance of this “noitic market”, and the measure of success will be improvement in human development. The responsibility of the “merchants” of the “noitic market” will be to design the strategies and the systems for education and information which can accomplish this.

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