Chapter 1

Overview of Information Technology and the Media

Introduction

This chapter has three objectives. The first is to place the subject of this book, namely, information technology and the media, in the context of the revolutionary changes that are occurring, and to describe how information technology is a subset of overall science and technology development. The second objective is to draw out the boundaries of information technology and the media once the nature, scope and characteristics of information is understood and defined. A plethora of terminology has emerged surrounding information and knowledge in the literature. Some demarcation is attempted even as subtle distinctions are becoming blurred. The third objective is to discuss methodologies to measure information as a service sector, or even as a quarternary sector, over and above the traditional primary, secondary and tertiary sectors.

In unravelling these concepts and definitions, this chapter hopes to bring enlightenment and clarification to a number of terms and terminology. Until the nature, coverage and definitions of what is information technology and the media are clear and unambiguous, the analysis of issues, problems, challenges or prospects cannot even begin meaningfully. This chapter is a core chapter in this respect.

A Revolution in Information and Communications Technology

A convergence of trends in economics, globalisation, technology and industrial restructuring on one the hand, and socio-political transitions in the capitalist and socialist topography on the other, have occurred (Drucker, 1996, 1997;

Thurow, 1996). This mega shake-up was accompanied by an unprecedented economic boom and socio-cultural renaissance across the Asia-Pacific region (Naisbitt, 1995; Lassere et al., 1995). The East Asian economic miracle was made more stark by its relative eclipse of Anglo-Saxon dominance (McRae, 1994). Since 1997, fortunes have again changed as the Asian meltdown caught up with the hubris. With such frequent turns of volatility due to capitalism or technology, the age of uncertainty (Handy, 1994) is harder to predict.

The world is getting both bigger and smaller (Naisbitt, 1994) with new communications technology decimating the tyranny of time and space across a borderless world (Ohmae, 1990). The key force lies in the transition from Bell's (1973) post-industrial society to Drucker's (1993) post-capitalist society, which was envisioned as the third wave (or powershift) by Toffler (1980, 1990). A knowledge society featuring information technology (Campbell, 1991; Drucker 1996, 1997) or a digital economy (Tapscott, 1995), where individuals and enterprises create wealth by applying knowledge and networked human intelligence, has dawned.

An overview of new technologies

After steam power, coal, steel and oil, the fifth wave of technology is powered by microelectronics. Broadly understood, *technology* is the application of scientific knowledge, with information technology as an important subset that specifies ways of doing things in a reproducible manner (Castells, 1996: 29–30). More specifically, *information technology* comprises a converging set of technologies in microelectronics, computing (hardware and software), telecommunications, broadcasting, optoelectronics and even genetic engineering with its expanding set of developments and applications. The argument for including genetic engineering lies in its involvement in the decoding, manipulation and reprogramming of the information codes of living matter (Castells, 1996: 30). New technological trends that come with microelectronics include diminution, digitisation, computerisation, the globalisation of communication, instantisation, customisation, automation, robotisation and leisurisation (Makridas, 1990).

All technologies increase our ability to process matter and information. In particular, information technology increases the amount of information circulated and/or preserved. Apart from any technical or productivity aspects, the ability of information technology to enhance or erode the social structures that contextualise it implies that social relations are merely a reflection of the new technology (Couch, 1996).

The sequence of the information technology revolution

Technological changes and transformations occur so rapidly and in such quantum leaps that even the starting point of the development of electronics-based information technology is not an easy consensus. The telephone was invented by Bell in 1876, the radio by Marconi in 1898 and the first programmable computer and transistor only in the mid twentieth century. From the transistor (invented in 1947), which enabled the processing of electric impulses in a binary mode at a fast pace, further development of processing devices in semiconductors and chips has occurred. In 1971, Intel's breakthrough with a computer on a chip or microprocessor increased both the capability and portability of information processing power. The computer, as the mother of all technologies since World War II, was firmly and irrevocably established.

One timeline for the information technology industry describes a four-phase evolution (Moschella, 1997: ix; see Fig. 1.1):

(i) a systems-centric system between 1964 and 1981,
(ii) a personal computer-centric system between 1981 and 1994,
(iii) a network-centric system between 1994 and 2005,
(iv) a projected content-centric system between 2005 and 2015.

Corresponding to the four periods are four operating laws (Moschella, 1997: 15, 101, 264–65):

(i) *Grosch's Law*. A computer pioneer, Robert Grosch, states that computer power increases as the square of the cost.
(ii) *Moore's Law*. Intel's co-founder, Gordon Moore, states that the semiconductor's performance will double every two years for the foreseeable future.[1]
(iii) *Metcalfe's Law*. Robert Metcalfe, inventor of the Ethernet and founder of 3Com, states that while the cost of a network expands linearly with increases in the network's size and semiconductor density, which doubles

[1] Moore forecasted that computing power will double every eighteen months to two years and that, by 2006, Intel's forecasts are that chips, together with smaller-sized computers, will be one thousand times as powerful and cost one-tenth as much as they did in 1996 (Cairncross, 1997: 9–10).

every 18–24 months, the value of a network increases exponentially. Thus, as networks expand, they become dramatically more cost-effective.

(iv) *The Law of Transformation*. It states that the extent of an industry's transformation will be equivalent to the square of the percentage of that industry's value-added, which is accounted for by pure information (bit), as opposed to atom-processing activity. This implies that the next technological wave will be grounded in the relationship between content and transformation.

	Systems-centric 1964–1981	*PC-centric 1981–1994*	*Network-centric 1994–2005*	*Content-centric 2005–2015*
Users	Business	Professional	Consumer	Individual
Technology	Transistor	Microprocessor	Communications bandwidth	Software
Law	Grosch	Moore	Metcalfe	Transformation
Network focus	Data centre	LANs	Public networks	Transparency
Supplier structure	Vertical integration	Horizontal integration	Converged horizontal	Embedded
Supplier leadership	US systems	US components	National carriers	Content providers

Fig. 1.1. A timeline for the information technology industry
(*Source*: Adapted from Moschella, 1997: ix)

The first wave featured a vertically oriented industry structure with the International Business Machine (IBM) as the overwhelming industry leader between 1964 and 1981 as it built, sold and serviced all of its key mainframe parts. Essentially, in a *vertically oriented industry*, speciality companies revolving around the central systems company (IBM, in this case) provide all the products and services. The vertical industry structure is a comfortable, if expensive, compromise for consumers. There is supplier and architectural stability, which simplifies user technology decision-making and facilitates long-term customer-supplier partnerships.

The first wave of vertical integration gave way to the second, highly disintegrated horizontal supplier structure. With a *horizontal supplier structure*, as seen in the personal computer market, every slice of the market is led by different sets of vendors. These vendors have an extraordinary level of supplier specialisation in keyboards, monitors, disk drives, floppy drives, compact disk-read-only-memory (CD-ROMs), dynamic random access memory (DRAMs), microprocessors, graphic chips, communications boards, sound cards, applications and delivery and service channels.

In fact, a unique trio of mutually self-reinforcing vendors—Intel, Novell and Microsoft—existed in a virtuous circle in the personal computer-centric system (Moschella, 1997: 34). Each occupied essentially neighbouring layers of the information technology value chain, which meant that what was good for one was almost always as good for the others. Faster Intel chips can run more powerful applications, which benefits Microsoft. Novell will also prosper as the need for more networking leads to stronger demands for faster chips and so on. A rare and powerful virtuous circle exists with each monopoly extracting very high profits, but their core interests are in such alignment that they may as well have been one company, or have been virtually vertically integrated as in the IBM example. Intel had nearly 90% of the microprocessor market, Novell enjoyed a near monopoly with some two-thirds of the personal computer local area network (PC LAN) operating system (OS) software market, and Microsoft had nearly 90% of the personal computer operating system market (Gates, 1995; Wallace, 1997).

Microsoft tried repeatedly, but unsuccessfully, to move into the local area network operating system (LAN OS) business in the 1980s, just as Novell tried to penetrate the DOS-compatible operating systems market with forays into the word processing and spreadsheet business. Apple's decision not to licence its Macintosh operating system gave Microsoft years to develop a comparable graphic user interface. The failed merger between Lotus and Novell in the early 1990s also gave Microsoft a clear way ahead. IBM eventually acquired Lotus and Novell acquired WordPerfect instead, losing its focus on its core networking business.

The three companies (Intel, Novell and Microsoft) enjoyed IBM-like power as the rest of the personal computer industry became increasingly commoditised (Moschella, 1997: 37). Other than the microprocessor, most of the hardware in a personal computer were commodity products, and nearly all of these components were produced by vendors other than the personal computer hardware vendor.

In the third wave of the network-centric power (1994–2005), the average cost of software will fall with virtually infinite supplier economies of scale. The marginal cost of an additional copy is next to nil, resulting in an asymptotic average cost curve (Moschella, 1997: 105). Metcalfe's Law shows that, as the cost of expanding a network tends to increase linearly as additional nodes are added, the value of the network can increase exponentially. Thus, the larger a network becomes, the greater its potential value. The more units of software sold, the cheaper each unit theoretically can become. The two forces become mutually reinforcing and this results in enormous value creation opportunities and the spawning of new economic activities. The same occurred in the telephone industry.

Convergence

Another phenomenon of new technologies is that of a global economy emerging as a product or convergence of capital, corporation, consumer and communications (the four C's), or the corresponding vectors of infrastructure, investment, individual choice and information technology (the four I's). With borderless economics, the four C's, or four I's, effectively spell the end of the nation-state and the rise of regional economies (Ohmae, 1995). The dysfunctional state becomes a symbol as these forces sweep across electronic highways.

In another interpretation, the evolution of markets in three vignettes starts with the circuit of capital first involved in the barter of commodities, that is, C-C (capital-commodity) (Perelman, 1991: 15–18). When money is used instead of barter trade, the vignette becomes commodity-money-commodity, or C-C-C, with the second C representing commodity used as money. By the time electronic money enters as another mode of payment, it creates its own interpretation in the more complex, modern economy where information becomes an important aspect in the C-C-C paradigm.

Many new communications technologies came with the advent of the Internet, which grew from a free and cheap academic application for data communications and transmission to commercial applications (see chapter 7). Companies are setting up intranets within single locations and extranets with branches and partners. *Intranets* represent a shift away from the internal company network using a local area network (LAN) to linking internal networks using both Internet technologies and Internet infrastructure within single locations. Its extension to branches and partners, including customers and suppliers, gives rise to *extranets*. The Internet offers a new platform as a fundamental technology for building new markets.

The Internet works on the simple philosophy that networks want to connect and once a universal way of getting networks to share data is broken through, a new paradigm in communications and exchange is unleashed (see chapter 7). Being in the public domain, nobody owns the Internet and nobody charges a fee for its use. The economics of cyberspace does not seem to exist as users surf and freeload for practically nothing after allowing for the monthly fees of Internet service providers and basic telecommunications charges.

There is no accurate way to count individual users of the Internet; the number of hosts or computer addresses is the next best proxy (*Far Eastern Economic Review*, 27 July 1995). Since 1991, the number has roughly doubled every year, but even host numbers can be misleading. A standard methodology assumes ten users for every host, translating to fifty million Internet users worldwide. But Asia has fewer users per host and fewer hosts per capita compared to Europe and North America, though this may be changing. The World Wide Web (WWW) offers an interactive brochure that serves as a table of contents to the Internet's vast resources and websites have multiplied tremendously.

As the Internet is mostly software driven, a concomitant growth in the software industry follows (see chapter 7). In turn, the booming computer industry (see chapter 4) is throwing a plethora of activities together, beginning with the merger of computers and telecommunications. The convergence of other industries includes office equipment and automation, electronics, recreation, entertainment, multimedia, education and many more. Industry lines are getting blurred, mixed and matched along the common thread of information technology.

As the power and reach of the communications infrastructure expands, the tools—namely, the computers—needed to harness that capability, shrink in size. Computers have become smaller, cheaper, lighter and more portable. Personal intelligent communicators, personal digital assistants (PDAs), personal communications devices (PCDs), or picocomputers, wireless communications and automatic interpreting telephony are already realities.

Alliances and raids as telephone companies invade each other's territories in partnership with cable companies are part of the new corporate terrain. Technology-driven strategic alliances produce strange bedfellows as traditional arch-rivals team up and cross-industry and cross-country alliances form as a result of deregulation, liberalisation and privatisation.

To dramatise the outcome of a seamless, global, digital network of networks, the parable of a theologian asking the most powerful supercomputer, "Is there a God?", was answered in the affirmative after it was connected with all other supercomputers, mainframes, minicomputers and personal computers in the world (Naisbitt, 1993: 98). Just as the space programme was about more than putting a man on the moon, the telecommunications revolution is about creating new technologies, expanding economic horizons, and accepting and meeting challenges. Digitisation will consummate the marriage among television, computers and telephones, and individual freedom will assume new meaning as this convergence takes place.

Digital technology allows broadcasters to send up as many as six separate sound tracks in different languages with the same video signal. Digital compression allows more channels to be packed into a smaller number of transponders. Signals can be received from new, powerful 25 cm dishes which cut costs to viewers and allow others, whose countries have banned the dish, to receive broadcasts as the dish is small enough to hide.

While the titans of media and communications wage war over the digital future, the Internet, a loose confederation of interconnected networks, which has been in existence for the last twenty-five years for scientists and academicians, has become more multimedia-oriented since mid-1993 (*The Economist*, 1 July 1995). A combination of software and a way of connecting documents that allows users to travel the network with pictures, sound and video became the rage of information, communications, education and fun. *Cyberspace* was spawned as a new medium based on broadcasting and publishing plus interactivity.

Industry value chain

The information technology industry *value chain* comprises vendor support and professional services, which account for about one-third of the total value added, followed by distribution channels, packaged software, peripherals, processors and semiconductors in fairly equal proportions (see Fig. 1.2). A distinction is made between software and content, where software refers

Vendor support and professional services
Distribution channels
Packaged software
Peripherals
Processors and semiconductors

Fig. 1.2. Value chain in the information technology industry

primarily to specific computer programmes, as in operating systems, tools, applications, interfaces, protocols and so on (see chapter 7). Software consists of a set of instructions while content revolves around some form of information as in text, images, sound, video or a combination thereof.

Figure 1.3 shows the value chain in the personal computer industry. Personal computer manufacturers are involved in the first four items in the hardware value chain: namely shape, colour, feature mix, service and price. Component manufacturers account for the rest of the value chain. As a result of the commoditised nature of the personal computer industry, the personal computer hardware vendor is responsible for only a small share of the value added in a personal computer. Even this portion generally consists of soft features such as shape, packaging, feature mix, service and others, including price (see Fig. 1.3).

Hardware Value Chain	Shape, colour
	Feature mix
	Service
	Price
Component Value Chain	Monitors
	Keyboards
	Mice
	CD-ROMs
	DRAMs
	Disk drives
	Microprocessors
	Other semiconductors

Fig. 1.3. Value chain in the personal computer industry

The inevitable result is that personal computer suppliers found it virtually impossible to differentiate their products as everyone uses the same component sources. Product competition shifted toward channel management, time-to-market, service, price, feature mix, and product and company branding, as best exemplified by Compaq Computer.

Over time, the four C's (computers, communications, consumer electronics and content) will become a converged information technology value chain

(Moschella, 1997: 114, 116–117). Digital technology has brought them together with multimedia, as manifested by the Internet, which is basically a merger of the computer and telephony industries. However, the overall horizontal information technology industry structure will remain; that is, five broad categories (hardware, software, transmission services, professional services and content businesses) of each of the four Cs will remain largely separate.

Nonetheless, components within each of these five categories will overlap, compete, merge and eventually become rationally structured to create a converged horizontal structure. The converged hardware market will link up end user devices and backbone network equipment. The integration of end user devices in personal computers, smart televisions, cable set top boxes, network computers, smart telephones, personal digital assistants (PDAs), video cassette recorders (VCRs), compact disc (CD) players and stereos is already happening to a greater degree than with network equipment.

Definitions and concepts

Some basic definitions and concepts are useful at this stage before looking further into the information and knowledge economy and society. The meaning of *information* is precisely and succinctly put as a reduction in uncertainty (Arrow, 1979: 306). A seminal definition of information is based on the concept of entropy (Shannon & Weaver, 1949). Total *entropy* represents complete randomness and lack of organisation; the greater the entropy, the higher the level of uncertainty. Thus, there is concordance with Arrow in that information is whatever reduces uncertainty. It also follows that information is only information if it represents something new, making a measure of information the "surprise value" of a message (Krippendorf, 1986).

Information is any experience or contact that adds new meaning or somehow changes events, lives or experiences. Information may be in the form of facts, opinions or algorithms, and may be transmitted and reproduced. While information is generally durable and permanent, as in a body of knowledge that has been built up, it can become obsolete if not updated, expanded and changed when necessary. It can be transmitted in many forms, as in audiovisual, sight, sound, touch, taste and smell which are not exclusive and can be mutually inclusive, as in a multimedia presentation of information. Information enables the user to know about something and to use that knowledge to relate, learn, think and decide as needed.

Information is the raw material of knowledge just as wood is the raw material for a table. Knowledge is a form of capital, and technology is an application of knowledge to work. *Knowledge* is cognitive information that has been generalised and abstracted from an understanding of the cause-and-effect relations of an event or phenomenon. *Cognitive information* is itself defined as logical and action-selective information that is a projection of the future or that is used for detecting and forecasting (Masuda, 1990: 160).[2]

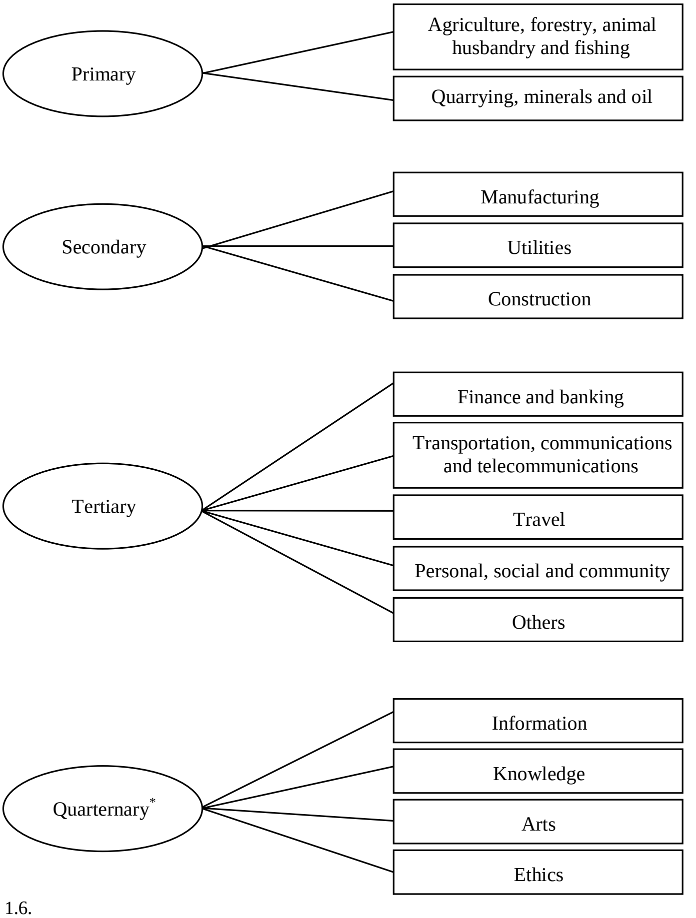
The principal benefit of knowledge lies in the enhancement of the knowledge base and structure. An increment of information leads to a modification in the existing knowledge structure, which gives rise to a new knowledge structure as the old structure is modified with new knowledge (see Fig. 1.4).

Fig. 1.4. Change in knowledge structure

The omnipresence, variety and power of information can be structured such that the need for information varies with its position in an organisational hierarchy. But the value of information is inversely correlated with quantity; too much can lead to *information overload*, excessive information that is more useless than useful. To be of real value, information has to be processed (this is essentially information reduction) to unveil and highlight core information in a precise and direct manner.

Information is increasingly becoming a distinct fourth factor of production instead of being implicitly embedded or embodied in the traditional factors of land, labour and capital. In parallel, apart from the traditional primary, secondary and tertiary sectors, a fourth sector in information may be evolving. This *quarternary sector* would comprise a new classification of information-related industries distinct from tertiary service industries (see Fig. 1.5). As information becomes an important and distinct input to production, consumption and other aspects of daily life, the activities of generating, producing, processing, transmitting, disseminating, distributing, storing, archiving and retrieving information constitutes an *information industry*. While conceptually

[2] Cognitive information is distinct from *affective information*, which is based on sensitivity and the production of emotion as in all information that conveys sensory feelings (Masuda, 1990: 160).



*See figure 1.6.

Fig. 1.5. Industrial and economic structure

distinct, the information industry is, in reality, pervasive and diffused across industries. The scope of the information industry is wide-ranging: from education to fun and recreation, or simply anything that involves information.

The impact of information in terms of economic, political, social, technological and cultural aspects are diverse, as the rest of the book will reveal. Information is power and various power roles may be discerned according to the organisation or hierarchy that controls the informational resources. Power relationships can exist at many levels including that of producer, authority, investor, client, auxiliary, creator, trade unionist, distributor, exhibitor, linking pin, facilitator, public advocate or members of the public in their various capacities.

Using a threefold definition, *information economics* is a framework of tools and concepts that enables: 1) a definition of value built on an expanded vision of benefit, 2) a definition of cost that includes explicit considerations of potential risk and 3) a decision-making process to make investment decisions in a manner consistent with business investment decisions (Parker & Benson, 1988: 5). Information economics looks at the supply side of production and investment in information infrastructure (dubbed infostructure) as well as the demand side, as in the consumption of information goods and services. The usual framework is in both microeconomics (consumer theory and firm theory) and macroeconomics (overall economy, public policies and the international arena).

Information seeking is the purposive acquisition of information from selected information carriers (Johnson, 1996: 9). Information seeking is beneficial as it is a moderator between perceived threats and the likelihood of taking action. It leads to an increased readiness to change. Ignorance and information are intertwined, though there can be some benefits to ignorance as well. Ignorance gives some comfort of denial, more anomie behaviour, lower information processing costs, lesser and lower conflicts, and less resistance to other's control and influence.

Knowledge economy

A distinction between information and knowledge follows, no matter how spurious it may be. The information economy, which will be elaborated upon shortly, is simply one that is knowledge-based. Both the knowledge economy and the information economy are associated with the digital economy as knowledge and information are conveyed in digital form. Following the revolution in information and communications technology, the emergence of the *knowledge economy* represents a shift from raw materials and capital equipment to information and knowledge as inputs for production.

In the information age, the resource that matters is intellectual rather than physical. The *raw material economy* premised on land (including all natural resources and climate) is uncoupled from the industrial economy, just as manufacturing is uncoupled from labour (Drucker, 1992). More precisely, the knowledge economy means a shift in the geographic centre from raw materials and capital equipment to information and knowledge, especially in education and research centres and man-made brain industries. The knowledge economy depicts the automation of labour-intensive manufacturing and service activities as well as growth in new service industries such as health care, distance learning, software production and multimedia entertainment.

The knowledge economy has altered traditional trade theories that explain why nations trade. The traditional factors of production and a relative abundance of factor endowment, based on geography under the Hecksher-Ohlin theorem as a basis of comparative advantage, seemed suited to agricultural products and some manufactured products. For new knowledge industries, such as in brain services, a theory of acquired or artificial competitive advantage (Porter, 1990) is more useful in explaining new activities associated with information technology. Competitive advantage can be simulated with policies to manipulate a conducive environment, whereas comparative advantage is based on the natural endowment of resources. With progressively shorter technology and product cycles, leapfrogging and more dynamic changes at a faster pace can occur with competitive advantage. This explains the role of information technology and information infrastructure in economic growth and development.

Information economy

The emergence of a knowledge economy is parallel to that of an information economy. To be clear, an *information economy* is one in which information is the core of a society's economic needs.

An information economy is dependent on knowledge and information, which are becoming increasingly science-based and applied to production (Carnoy et al., 1993: 5). At the global level, a new pattern of international divisions of labour will result as multinational corporations (MNCs) with information technology resources can wield immense power (chapter 10). This is precisely why the question of whither the nation-state in the new international economic order is posed (Ohmae, 1995; Carnoy et al., 1993). Moreover, the economic structure will change to involve the expansion of the public economy. The state has to strengthen its national information infrastructure (NII), or infostructure, as externalities are involved and set rules of conduct exist both domestically and internationally.

Because information technology is transmitted through digitised technology, the *digital economy* is one in which individuals and enterprises create wealth by applying knowledge, networked human intelligence and effort to manufacturing, agriculture and services. The meaning of a digital economy

(A) Information Industries

Private information industries	Investigators, forecasters, freelance writers and public opinion surveyors
Printing and publishing industries	Printing, plate making, bookbinding, publishing and photostat copying
News and advertising industries	Newspapers, news agencies, magazines, advertising and public relations
Information processing and service industries	Computer centres, data banks, software houses and time sharing services
Information machinery industries	Printing presses, computers, terminals, typewriters and duplicating machines

(B) Knowledge Industries

Privately operated knowledge industries	Lawyers and accountants
Research and development industries	Research institutes and engineering companies
Education industries	Schools and libraries

(C) Arts Industries

Private affective information industries	Novelists, composers, singers, painters, photographers, promoters and producers
Affective information service industries	Theatre troupes, orchestras, motion picture companies, television companies, movie theatres and recording companies
Affective information equipment industries	Equipment in photographic, musical, filming, recording and television companies

(D) Ethics Industries

Private ethics industries	Philosophers, religious leaders and prophets
Religious industries	Religious groups, churches, temples and shrines
Spiritual industries	Zen, meditation and yoga groups, spiritual training centres and volunteer service groups

Fig. 1.6. The quarternary of information-related industries
(*Source*: Adapted from Masuda (1990))

will probably become more entrenched as analogue transmission gradually gives way to digital technology and all forms of information (visual, audio, graphic, data and others) can be digitised.

An information industry, as distinguished from a knowledge industry, marks the attainment of an information-led type of industrial structure as the first stage of change in the economic structure (see Fig. 1.6). The *information industry* is responsible for the production, processing, storage and dissemination of information. It comprises the production of computer/office machinery, communications cables and equipment, information transmission, software, information processing services, information retrieval services, information storage and archival services.

The information industry is a generic one, including privately operated information industries (eg, investigators, forecasters), industries in printing and publishing (eg, printing, bookbinding), news advertising (eg, newspapers, magazines), information processing services (eg, computer centres, databanks) and information machinery (eg, printing press, computers). On the other hand, knowledge industries comprise privately operated knowledge industries (eg, lawyers, accountants), research and development industries (eg, research institutes, engineering companies), education industries (eg, schools, libraries) and knowledge equipment industries (eg, electronic calculators, computer-aided instruction equipment) (Masuda, 1990: 68). It is thus reasonable to distinguish information-related industries as quarternary industries distinct from tertiary or service industries in general.

Information society

Parallel to a knowledge-based information economy is the emergence of an information society. An *information society* is one that grows and develops around information and brings about a flourishing state of human creativity instead of mere affluent material consumption. More rigorously, the concept of an information society requires two premises (Masuda, 1990: 1). One involves the production of information values, not material values, as the driving force behind the formation and development of the information society. The other premise is that past developmental patterns of human society can be used as historical, analogical models for future societies.

An alternative definition of an *information society* is one in which the quality of life, prospects for social change and economic development depend increasingly on information and its exploitation (Martin, 1995: 3). One step beyond an information society with an ongoing information revolution is a *broadband society*, which is one where telecommunications has become the true catalyst for change. There is virtually unlimited access to information, and traditional universal telephone services will be replaced by universal multimedia information services. In fact, instead of an information society, many possible information societies may be spawned.

Information societies will result in economies in which information is the core of society's economic needs. Both the economy and society grow and develop around the core of production and use of information values. Information, as an economic product, will exceed goods, energy and services in importance (Masuda, 1990: 66). The information society will be a reality following four stages of computerisation (Masuda, 1990): big science-based computerisation (1945–1970), management-based computerisation (1955–1980), society-based computerisation (1970–1990) and individual-based computerisation (1975–2000).

Key features of an information society include the omnipresence of computers, synergistic production and shared utilisation in information resources, a participatory democracy and a voluntary community. A *participatory democracy* results when policy decisions are reached with the participation of people who are less satisfied with mere material wants and whose chief desire is self-realisation. The means to more information is available in an information society, but problems remain. Challenges include the creation of available, fair and accurate information, equal access to information, mechanisms for people to participate in matters concerning state sovereignty, and dealing with problems that cannot be solved by a simple majority since some minority rights have to be respected.

Simultaneously, people in a voluntary community are bonded by common goals and a shared philosophy; they voluntarily carry on life together under a common social solidarity. An application of this is the informational voluntary community, which is the technological base of computer-communications networks.

The goal of an information society is to satisfy human needs, which will have some new elements including self-determination. Societal productive power is the basis for the satisfaction of human needs and the production of information- and goal-oriented action. A vision of computer utopia, or computopia, is an ideal global society in which multi-centred, multi-layered communities of citizens, participating voluntarily in shared goals and ideas, flourish simultaneously throughout the world (Masuda, 1990).

Information societies are clearly underpinned by the telecommunications revolution, which changes economic production and consumption, spreads democracy and gives it urgency. The telecommunications industry, encompassing telephones, televisions, computers and consumer electronics, is struggling with four trends. The first trend is the blending of technologies in telephone/television/computer hybrids. The second trend is the swing towards strategic alliances. This, in turn, leads to the third trend: the creation of a seamless, global network in the form of a digital web of networks. Finally, there will be a growing phenomenon of personal computers for everyone as market forces push the diffusion of applications.

An information society based on knowledge creation and utilisation represents a transformation from an industrial society, which is a high mass consumption society, to a high welfare society and, finally, to a high mass knowledge creation society. In contrast, a post-Fordist, post-Taylorist economy represents, respectively, mass production in assembly lines and the application of scientific management. Some fundamental differences exist between post-capitalist industrial societies and knowledge societies in terms of organisation, behaviour and outcome (see Fig. 1.7).

Industrial Societies	*Knowledge Societies*
Hierarchy	Equality
Conformity	Individuality and creativity
Standardisation	Diversity
Centralisation	Decentralisation
Efficiency	Effectiveness
Exhaustion of natural resources and pollution	Resource-saving and symbiosis with nature
Consumption and material productive power	Technology assessment
Specialisation	Generalist, interdisciplinary and holistic
Individualism	Synergism
Maximisation of material wealth	Quality of life and conservation of material resources
Emphasis on quantitative content	Emphasis on quality of output
Security	Self-expression and self-actualisation

Fig. 1.7. Industrial societies and knowledge societies

The Nature and Scope of Information Technology and the Media

The core sectors in information technology lie in computers, telecommunications and semiconductors (Guysters, 1996: 4). They are the means, technology and mechanisms through which information is produced, processed, transmitted, archived and retrieved. Increasingly, the movement of information is not just among individuals, organisations, industries and other entities in disaggregated transactions or exchanges. Where information is public and more effectively processed and disseminated in an aggregate mode, the role of the *mass media*, as in newspapers and broadcasting (radio and television, as well as newer forms such as cable television) is apparent (see chapter 4).

Mass media and media systems imply interrelatedness and the existence of technological vehicles through which mass communication takes place. *Mass communication* is about the creation of messages, the use of technology, the involvement of large numbers of people, and the implications of it all. It is the industrialised production, reproduction and multiple distribution of messages using technological devices. Mass communication helps to shape people's understanding of the elements that make up society.

Newspapers, magazines and periodicals
Broadcasting, radio and TV
Advertising

Fig. 1.8. The mass media industry

Figure 1.8 shows components of the mass media industry (compare with Fig. 1.2, which depicts the main players in the information technology industry—vendor support and professional services, distribution channels, packaged software, peripherals, processors and semiconductors). Newspapers, magazines, periodicals and other printed forms convey information on a mass basis. Broadcasting, as in radio, television, cable television, videos and such, is another mass media industry. Apart from conventional broadcasting, satellite broadcasting opens up a new window in mass communication. Advertising is considered a mass media industry, not only because it involves mass dissemination of information, but also because it is a vital form of revenue for other mass media players.

The Measurement of Information and Services

Conceptualising the information sector

Measurement necessarily comes after conceptualisation. A distinction is necessary between a sector and an industry. Traditionally, an economy has three sectors (see Fig. 1.5): the primary sector (ie, agriculture, forestry, husbandry, fishing, mining and all activities related to the land), the secondary sector (ie, construction, utilities and manufacturing) and the tertiary sector (ie, services). As noted, a quarternary sector may be the information sector. An *industry* is a collection of firms producing a similar category of goods or services. An information industry consists of all firms involved in generating, processing, disseminating or storing information. An electronics industry comprises all firms producing electronic goods. In other words, industries are clusters of firms that make up the sector.

Machlup (1962) was the first to conceptualise the *information sector*, leading to its measurement. His first listing identified five areas: education, research and development (R&D), communications media, information machinery and information services.

Porat (1977) took the concept and definition of the information sector further, and more rigorously, by distinguishing between primary information sectors and secondary information sectors. In trying to define a primary information market, Porat claimed that no single definition of information embraces all aspects of a primary information sector. To him, information is easier to define by example than by direct appellation. The end product of all information service markets is knowledge. Knowledge can be an end in itself, but it is usually applied in the acquisition of something. To qualify as an information service, knowledge does not have to be neither good nor true as distortions, inaccuracies and even lies also constitute information. Information is whatever enables a consumer to know something that was not known before.

In Porat's typology of primary information industries, which covers eight major parts, he showed the ways in which knowledge and information can be produced, processed, disseminated or transmitted. A *primary information market* is formed when firms, using a technology of organisation, produce and distribute information at an exchange price. The eight major parts of primary information industries, which in turn can cover hundreds of industries that, in some way, produce, process, disseminate or transmit knowledge or messages, are:

(i) Knowledge production and inventive industries
  (a) R&D and inventive industries (private)
  (b) Private information services
(ii) Information distribution and communications industries
  (a) Education
  (b) Public information services
  (c) Regulated communications media
  (d) Unregulated communications media
(iii) Risk management
  (a) Insurance industries (components)
  (b) Finance industries (components)
  (c) Speculative brokers
(iv) Search and co-ordination industries
  (a) Search and non-speculative brokerage industries
  (b) Advertising industries
  (c) Non-market co-ordinating industries
(v) Information processing and transmission services
  (a) Non-electronic-based processing
  (b) Electronic-based processing
  (c) Telecommunications infrastructure
(vi) Information goods industries
  (a) Non-electronic consumption or intermediate goods
  (b) Non-electronic investment goods
  (c) Electronic consumption or intermediate goods
  (d) Electronic investment goods
(vii) Selected government activities
  (a) Primary information services in federal government
  (b) Postal services
  (c) State and local education
(viii) Support facilities
  (a) Information structure construction and rental
  (b) Office furnishings

To be accounted in the primary information sector, the good or service must intrinsically convey information or be directly useful in producing, processing or distributing information. Inputs to information industries are excluded. While these inputs originate from industries that are closely associated with information industries, they do not sell information goods and services *per se*.

While the *primary information sector* produces information machines, or markets information services as a commodity, the *secondary information sector* comprises public and private bureaucracies that have planning, programming, scheduling and marketing activities. These activities are not directly counted in national accounts since information services and their values have to be imputed.

Input-output tables

There are peculiar difficulties involved in measuring intangible services, especially if they are transborder data flows (TBDF) or over-the-wire flows. Other difficulties involve the quality and productivity of services. Services are measured by the conventional system of national accounts (SNA) in terms of the total market value of all goods and services produced in a country, as in the gross national product (GNP), which is based on nationality, or the gross domestic product (GDP), which is based on geographic territory.[3]

The balance of payments records the export and import of services together with merchandise goods and other unrequited transfers in the current account, whereas capital flows are captured in the capital account. However, standard national output and income accounts are not conceptually organised to measure information industries. As information has become such a pervasive input in economic activities, the impact of the information sector is more clearly and effectively portrayed through input-output tables that show inter-industry linkages and transactions. Input-output tables enable multiplier analyses incorporating direct, indirect and induced effects. They show how changes in the final demand in one sector impinge on the others.

An understanding of input-output tables is germane at this stage (Jussawalla et al., 1988; Low, 1990; Low et al., 1994). Table 1.1 shows a simplified input-output table, also called a flow matrix, for four sectors in a hypothetical economy, namely, the primary sector, manufactured consumer goods, manufactured producer goods, and services. These four sectors form a matrix

[3] The total market value of all goods and services produced in an economy in a period (usually one year) by nationals inside and outside an economy is known as the gross national product (GNP), while the gross domestic product (GDP) is the total market value based on production within the economy irrespective of nationality. The difference between GNP and GDP is, thus, the net factor income from abroad. It is positive if there is more factor income accruing to nationals outside the country than factor income owing to non-nationals working in the economy.

Table 1.1. A hypothetical input-output table or flow matrix ($)

Row* \ Column+	Primary	Mfr consumer	Mfr producer	Services	Total intermediate uses	Final uses	Total use
Primary sector	20	65	50	10	145	245	390
Mfr consumer goods	0	30	0	0	30	260	290
Mfr producer goods	50	60	70	15	195	50	245
Services	40	15	50	70	175	200	375
Total purchases	110	170	170	95	545		
Value-added	280	120	75	280		755	
Total output	390	290	245	375			1300

+ Column indicates use or destination of output.
* Row indicates source or where output is produced.

in Table 1.2, with the columns representing users, or output, and the rows representing producers, or inputs. Thus, a particular cell shows what a producer needs as inputs and what use or output has been made. Reading across the first row, the primary industry, as a producer, sourced $20 as inputs from itself, $65 and $50 each from both manufacturing industries and $10 from services. These total $145 in intermediate inputs. The column on final uses represents the final demand for private consumption, including government purchases and exports, which is $245. A total of $390 worth of production has thus occurred for the primary sector as required by these destinations, or users. The second row contains the same information for the manufactured consumer goods sector, and so on. The fifth row describes the total purchases of intermediate inputs from the domestic economy. In addition, other inputs that create value added, such as wages for labour services and profits for companies, are shown in the sixth row. Adding all the purchases in the first column yields the total output for the primary sector: $390. This figure matches the total as total use in the last column.

The main four-by-four transaction matrix, reporting flows across the four sectors or aggregations of industries, depicts the inter-industry linkages that form the basis of input-output tables. It shows how industries are related to one another in the whole economy. When the final demand in an industry increases, a chain reaction or effect, in terms of the greater output demanded by other industries because their outputs have become inputs in the user industry (the one whose final demand has grown), will take place. This, if the information industry can be singled out and identified within the overall services sector, is how its economic impact can be measured and evaluated. In reality, an input-output table can contain hundreds of industries; it is a matter of how practical it is to collect and itemise the statistics and data along these divisions.

Input-output tables are used to measure economic impact by converting the flow matrix in Table 1.1 into a matrix of coefficients as in Table 1.2. Each column in Table 1.1 is divided by its industry output total to yield the ratio of input to output for each industry. The result is known as an A-matrix, which represents a set of production functions for each industry (see Table 1.2). These fixed coefficient production functions are called Leontief production functions. The elements, or coefficients, designated as a_{ij} shows i for the input (row) and j for the output (column). Thus, a_{12}, or a value of 0.23 (65/290), is the output of the primary industry needed for each unit of manufactured consumer goods.

Table 1.2. Input-output coefficients

	X_1	X_2	X_3	X_4
Primary goods X_1	0.05	0.23	0.20	0.03
Consumer goods X_2	0.00	0.10	0.00	0.00
Producer goods X_3	0.13	0.21	0.29	0.04
Services X_4	0.10	0.05	0.20	0.18
Total purchases	0.28	0.59	0.69	0.25
Value-added	0.72	0.41	0.31	0.75
Total output	1.00	1.00	1.00	1.00

The assumption of a fixed coefficient has enormous implications, which also translate into a fundamental weakness of input-output analyses, namely, that technology has been held constant to derive these ratios. In turn, this basic assumption requires that the prices of inputs also do not change. If they do, factor substitution, cheaper inputs for more expensive inputs, would alter the coefficients or ratios just as technological changes would. The assumption is accommodated because, in reality, technology is quite constant. Hence, input-output tables are usually collated every five years, instead of annually, since technology does not change so fast or so drastically.

What is more important is that a Leontief matrix comprising the core four-by-four transaction matrix can be used to calculate the economic impact of one industry's growth on others. For a four-sector economy, the following equations may be written to show the total output for each of the four industries:

$$X_1 = a_{11} X_1 + a_{12} X_2 + a_{13} X_3 + a_{14} X_4 + F_1 \quad (1.1)$$

$$X_2 = a_{21} X_1 + a_{22} X_2 + a_{23} X_3 + a_{24} X_4 + F_2 \quad (1.2)$$

$$X_3 = a_{31} X_1 + a_{32} X_2 + a_{33} X_3 + a_{34} X_4 + F_3 \quad (1.3)$$

$$X_4 = a_{41} X_1 + a_{42} X_2 + a_{43} X_3 + a_{44} X_4 + F_4 \quad (1.4)$$

Suppose the economy is projected to grow at a certain rate, such that the final demand of all four sectors will be similarly projected (ie, final demand F_1 in the primary industry X_1, final demand F_2 in the industry X_2, and so on). It is a matter of solving the set of four linear simultaneous equations which have four knowns (the final demands of the four sectors) and four unknowns (the output of the four sectors). The use of computer packages to solve much larger systems for a real economy is not a problem. Neither is fine-tuning to allow for changes in the fixed coefficient if technological or input price changes become significant.

In addition, multipliers that measure the effect of changes (eg, output multipliers, employment multipliers and income multipliers) can be computed. An *output multiplier* for a primary industry reveals the total value of production in all sectors of the economy required to satisfy a dollar's worth of final demand in the primary industry. Usually, output multipliers have values greater than unity because of the indirect demand generated for intermediate inputs in all sectors. In other words, when the final demand in one industry grows, other industries do not expand output in direct inputs for that industry alone. They also produce more for other industries whose outputs have also expanded due to an indirect impact or chain effect that is created across the whole economy.

An *income multiplier* shows the total value added or income generated in that industry as a result of a dollar's worth of the final demand of that industry. By the same reasoning, an *employment multiplier* shows the number of jobs created due to an increase in the final demand of a particular industry.

Input-output tables and multiplier analyses are useful for planning purposes when target growth rates and certain industrial transformations are projected for the economy. More specifically, when an information industry is identified in an economy's input-output tables, the methodology of analysis involves computing the effect on the information industry as a result of changes in other non-information industries.