Osamu Sudoh (Ed.)

Digital Economy and Social Design

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Preface

The advent of the digital economy has the potential to dramatically change the conventional interrelationships among individuals, enterprises, and society, and to make a considerable qualitative difference to major socioeconomic systems. The expanded applications of information technology have actually lowered the significance of boundaries between organizations and between countries, and have intensified competition among businesses and institutions. In addition, a paradigm shift of unprecedented dynamism is emerging in a very broad range of areas, from the world economic order to personal lifestyles. In the business world, for instance, more cross-sector collaborative relationships are being established and different business models are being integrated. In government, citizens' participation is growing and administrative functions are changing. Communications between different cultures via the Internet are expanding. In industrial, economic, institutional, educational, cultural, and many other spheres, interactions among different communities or countries are gathering pace and structural changes are accelerating at national and transnational levels.

These structural changes have just begun recently. Many are not fully in place. But there can be little doubt that to achieve vigorous socioeconomic development in the twenty-first century, people will have to aggressively use information technology to boost innovation and to organically link the results of that innovation to solutions to global environmental issues and social challenges such as the opportunity divide.

The digital economy has in fact been posting steady growth, even since the bursting of the new economy bubble. We now need dispassionate analyses of the impact of information and telecommunications technologies on socioeconomic systems and the development of a practical institutional design. In this sense, the compilation of such analyses into a single book is timely.

This book is based on an international conference on the establishment of the digital economy and the evolution of socioeconomic systems. The conference was

held on February 27, 2003, at the University of Tokyo. It was organized by Research Project A06, entitled "Researching the Emerging Global Information Economy and Designing a New Social System," which I had the honor of leading. This project has been designated as one of the "Informatics Studies for Building the Foundation of Deepening Information Technology," and as such is eligible for subsidies from the Ministry of Education, Culture, Sports, Science, and Technology to cover scientific research costs. The conference was cohosted by the Institute of Socio-information and Communication Studies at the University of Tokyo. Benefiting from the participation of an audience with a broad interest in the economy, business administration, and many other issues, the conference enjoyed a lively discussion. This book is a substantially rewritten version of the conference proceedings, adopted after strict peer review by anonymous reviewers and reflecting both the discussions that took place at the conference and subsequent trends in economic society.

The book consists of three parts, each featuring papers mainly based on theoretical research and papers centered on empirical research. Each part examines one topic, as follows:

Part I. The Macro and Micro Economic Aspect

Chapters 1 to 3 examine the impact of informatization on the overall socioeconomic system, what will be necessary to make effective use of information and knowledge to sustain the development of society and the economy, whether or not new technological innovation will aggravate inequality, and what skills, techniques, and institutional design will be required to ensure that different individuals and groups can broadly reap the benefits of the digital economy.

Part II. The Nature of Competition

Chapters 4 to 6 focus on the functions performed in the network society with its constantly changing organizational boundaries by the mechanism of credit rating and selection in the market, how businesses compete with one another in the digital economic environment, and how this competition differs from the existing competition.

Part III. Structural Changes

Chapters 7 to 9 assess how the digital economic environment changes the structure and management of enterprises and the government, how businesses, the government, and citizens will change after the information society emerges, and what forms of governance should be adopted.

The digital economy is by no means an inexorable and deterministic phenomenon. Rather, it is an ever-changing social framework. It is of significance to researchers. The object of their study is so complex that it often involves complex relationships. We are responsible for taking advantage of the opportunities opened up by the digital economy and for turning those opportunities into things that reflect our values and goals. This publication will have achieved its goal if the exploration and questions it raises serve as a signpost for other research projects and policy making.

I would like to conclude this preface by expressing my sincere gratitude to all those who offered support and cooperation in the publication of this book. In particular, I would like to give special thanks to Ms. Reiko Gotoh for her outstanding contribution to the planning and compilation of this publication, serving as a research partner in the project "Researching the Emerging Global Information Economy and Designing a New Social System" and also as secretary of the international symposium "The Establishment of the Digital Economy and the Evolving Socioeconomic Systems." I am also deeply indebted to Dr. Yuichiro Anzai, a professor of Keio University and field representative for "informatics" and others who willingly agreed to proofread for us, to the editorial staff at Springer-Verlag, Tokyo, for their great help with the publication of this book, and to the Ministry of Education, Culture, Sports, Science, and Technology for financially supporting our research project.

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Part I: The Macro and Micro Economic Aspect

1 The Knowledge Network in the Digital Economy and Sustainable Development

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Summary

Today, the global environment represents the most crucial issues we will have to face. Based on the principles of sustainable development, local residents, the government, local authorities and companies must cooperate under the banner of participatory local democracy, with nonprofit organizations (NPOs) playing a key role as junction points, to work toward the environmentally-friendly development of local communities. These local communities then need to be linked on a global scale to create a worldwide network for the development of a society that is geared towards preserving its environment. On this chapter, we consider on the interactive relationship between the market economy and technological development, and the evolution of information technology (IT) and the digital economy. Next, based on these trends, we will examine the relationship between the formation of a networked society and regional development. We will then go on to consider how IT and information networks can contribute to a new form of social development that is environmentally friendly.

Key Words Digital economy, Web-based community, Sustainable development, e-Government, Knowledge network

1.1 Introduction

Looking into the twenty-first century, the global environment represents the most crucial issues we will have to face. Yet, it is no easy task to come up with a basic design for the sustainable development of mankind, or to implement this basic design on more concrete levels. In reality, there is a complex web of factors, with each country facing its own specific problems that reflect its unique history, creating numerous conflicts of interest.

In the long term, as the threat of global environmental destruction grows ever greater, global networks that link regions to the world may prove a powerful force in the formation of new societal standards that will triumph over these nationalistic interests. Based on the principles of sustainable development, local residents, the government, local authorities and companies must cooperate under the banner of participatory local democracy, with nonprofit organizations (NPOs) playing a key role as junction points, to work toward the environmentally-friendly development of local communities. These local communities then need to be linked on a global scale to create a worldwide network for the development of a society that is geared towards preserving its environment.

This chapter begins with a look at the interactive relationship between the market economy and technological development, and the evolution of information technology (IT) and the digital economy. Next, based on these trends, we will examine the relationship between the formation of a networked society and regional development. We will then go on to consider how IT and information networks can contribute to a new form of social development that is environmentally friendly. More specifically, this chapter takes the case of the Zero-Emissions Research Initiative, and examines how the expansion of the digital revolution should be used to promote sustainable development.

1.2 The Market Economy and Industrial Networks

1.2.1 The Interactive Relationship Between the Market Economy and Technology

After World War II, a model for economic development that centered on mass production and mass consumption took hold in developing countries, and the world witnessed widespread environmental destruction. The causes of this massive degredation of the environment can be broadly divided into two. The first is the large-scale destruction of the environment that was brought on by the materialistic, wealth-oriented economic systems built by advanced nations, or namely systems of mass production and mass consumption, and the mass disposal that accompanied them. The second is the deterioration of natural resources, such as forests, water and soil, caused by poverty in developing countries, foreign exchange shortages and specializations in commercial crop production, the amassing of land by certain privileged classes, and rapid population increases. These two forms of environmental destruction are connected in complex and interactive ways.

Throughout the twentieth century, the words "progress" and "development" in most cases were used to mean "economic progress" and "economic development," and it is no exaggeration to say that the natural environment was seen as a given, and in this short-sighted view, the expansion of monetary wealth and material benefits took priority. Moreover, with the exception of localized water and air pollution, little consideration was given to the destructive effects of economic activities on nature until global environmental problems became much more serious.

Yet, economic activities dramatically boosted productivity (and our power over nature), and as a result, economic activities and technology came to have a massive impact on the natural environment. The assumption that the natural environment was a given for economic activity had by this stage become a thing

of the past. Let's begin by looking at the relationship between the market economy and technological development.

Here we shall look at the interactive relationship between technology and the market, based on the observations of Michael J. Piore and Charles F. Sable (Piore and Sabel 1984:38–48).

Piore and Sable have made some very interesting observations about the relationship between technological progress in America, England and France in the early nineteenth century and domestic markets. According to their findings, early nineteenth century America suffered from a shortage of highly-skilled workers, and unlike Europe, did not have guilds that restricted the organization of production. There were also numerous affluent independent farmers who had a certain degree of purchasing power. Given these market conditions, entrepreneurs needed to organize production processes to reduce their dependence on labor, and this in turn required the introduction of labor-saving machinery. What's more, the independent farmers, who comprised the majority of the consumer base, willingly bought up the standardized products manufactured using this machinery. By then, the foundations had already been laid for the development and introduction of mass-production technology in America.

Meanwhile in France, while French farmers owned the rights to control their own land, as did farmers in America, unlike their American counterparts, the majority of French farmers owned small plots of land and their livelihoods were not integrated with the market economy. Demand for manufactured goods thus came only from the aristocracy, bourgeois merchants, bureaucrats and the few affluent farmers.

Yet regional markets were very diverse in nature, causing segmentation in the domestic market. Guilds existed in France and although they did not have very strong regulatory powers, the highly-skilled workforce and sophisticated techniques cultivated by the guilds were used to develop new manufactured goods and manufacturing processes. These market conditions encouraged the French economy to specialize in producing a wide variety of high-quality goods. As such,

there was very little incentive in France to develop and implement mass-production technology at this time.

In early nineteenth century England fell somewhere between the two extremes of America and France. Land enclosure moves in England created a sharp division amongst independent farmers, with the majority of farmers losing control of their land and migrating to urban centers as workers. This generated a huge market for low-cost consumer goods in urban areas, while there was also a market for low-cost consumer goods in the colonies. On the supply side, merchandise production was beginning to be organized by those who had evaded the guild or state regulations. Meanwhile industrialization flowed over into rural areas, increasing the population density in rural areas, and as a result consumer preferences in regional areas became more stable. As England had an abundance of both skilled and unskilled workers, entrepreneurs did not need to come up with labor-saving initiatives. Consequently, while England developed mass-production systems in the cotton textiles, food processing and brewing industries, market conditions did not facilitate the aggressive development and introduction of non-labor intensive standardized mass production technology that was seen in the United States.

In this way, the "market" had a very different social function in each of these countries because of their differing economic climates. For this reason, the path of technological progress in each of these countries differs greatly, a reflection of their individual market peculiarities. Therefore, when examining the relationship between environmental problems and economic growth, we cannot consider the two in binary opposition, but must rather fully understand the interactive relationships between the underlying market characteristics, social systems, technology, governments, and social customs.

1.2.2 The Development of Industrial Networks

In nineteenth century Europe and America, many industrial areas achieved economic growth after organizing local industry networks. Some classic examples

of this include the silk textiles manufacturing industry in Lyon, the cutlery and specialty steel manufacturing industries in Solingen, calico manufacturing in Alsace, cotton textiles manufacturing in Philadelphia, and specialty steel manufacturing in St. Etienne. Piore and Sabel believe that there were specific mechanisms that facilitated economic growth in these areas (Piore and Sabel 1984:19-48).

Below are some important commonalities between these advanced industrial areas at the time, as identified by Piore and Sabel.

First, these industrial areas had found ways to readily adjust the combination of technology and capital equipment in the industrial system to adapt flexibly to fluctuations in demand. In Lyon and Solingen for example, small specialty producers joined together to form local industry networks. But there were no fixed relationships between prime contractors and sub-contractors, and the relationships between companies, or more accurately, the relationships between work places, were flexible and dynamic, with companies sometimes being the prime contractor and then at other times the sub-contractor. Therefore, the relationships between work places were organized and re-organized as needed to respond to fluctuations in demand, and local industry networks were formed that were both diverse and flexible.

Second, the work places and factories in these industrial areas placed great importance on innovation and worked to improve productivity, while they also had the capacity to flexibly cater to demand fluctuations and the ability to create new markets. In addition, producers made concerted efforts to adapt and apply technology developed for diversified applications. This meant that the development and use of advanced technology within these areas was fiercely competitive.

In Lyon for example, the jacquard loom was developed in the first half of the 19th century. With the introduction of the jacquard loom, punch cards were used to control textile patterns, increasing precision, and enabling the textile patterns to be changed simply by replacing the punch card. Using this jacquard loom, the Lyon textiles industry could successfully adapt to fluctuating demand. Meanwhile,

research into steam-powered engines and gasoline engines was underway in Solingen.

Third, to facilitate stable development of local industry, the local industry networks established systems that were very similar in nature to local co-operatives. For example, in Solingen and St. Etienne, vocational training schools were set up for the general benefit of the local community, and training and retraining in skills and techniques was systematically conducted. This provided a foundation for local communities, and enabled producers to cope with changes in technology and fluctuating demand appropriately. It also actively encouraged workers to develop expertise, scientific knowledge and creativity, ensuring continued innovation. The systems devised ways of acquiring not just techniques and skills, but broad-based information and knowledge, they maintained cooperative relationships between workers and management, and endeavored to restrict low-price competition that generates wage cuts and declining quality. In other words, they maintained economic order in the local community, and applied harsh entry restrictions to prevent excessive competition, ensuring that the welfare of members of the community was kept above a certain level.

In short, the many companies, or rather work places, in each industrial area, (1) became highly specialized, and ensured that production could be adapted to demand, and therefore (2) there was an invisible collective impetus throughout the community which encouraged the rapid adoption of technological developments and the latest technology in industry, thereby promoting competition. Meanwhile (3) price and wage competition, which would impede the adoption of technological innovation or the latest technologies in industry, was restricted through labor-management agreements, and market entry was restricted to ensure that the local community's high-quality human resources were regenerated. In this way, they responded to market fluctuations whilst maintaining a balance between cooperation and competition, and organized the market place.

So local industry networks were formed in nineteenth century Europe, and there were many successful examples of economic development in which

competitive and regulatory tools were used with harmony between market-oriented and non-market-oriented systems.

Subsequently, the 1920s saw the emergence of mass production systems used by the corporate giants. The plants constructed by American automaker Ford Motor Company in the period between the two great wars represented the new paradigm. The mass production system developed by Ford, otherwise known as the Ford System, was subsequently adopted around the world. After World War II, improvements to the social welfare system for unemployment benefits, pensions and health insurance relieved anxieties over unemployment, retirement and illness, while the introduction of installment sales generated a mass consumption base that would absorb this mass production. A development model based on mass production and mass consumption and known as Fordism, was established, and from the late nineteenth century through to the mid twentieth century, we saw the gradual disappearance of the development model that had centered on globally dispersed local industry networks.

Meanwhile, advanced counties like the United States, Western European countries and Japan invested large volumes of energy and resources to achieve remarkable economic growth. Under Fordism, economic growth is the major prerequisite for all manner of social functions, and innovation and mass production-mass consumption are essential elements in achieving economic growth. Even with an inequitable distribution of wealth, economic growth and job security mean that corporations can reap greater profits and workers can earn higher wages. Additionally, the consumption levels of the majority of the population is dependent on their income from wages, so the government now had to give priority to expansionary economic policies to sustain and generate employment, otherwise they would lose the support of the populace. Not adopting policies for economic expansion would result in less tax revenue, which would harm fiscal resilience.

Any environmental considerations at this point would have been little more than stopgap measures. Resources and energy were consumed in vast quantities, and corporate profit-motivated innovations and initiatives meant that products that

could still be used were simply discarded. Awareness of resource utilization and the environment started to grow in advanced countries from the late 1960s and 1970s, sparking a re-examination of the mass production-mass consumption concept. Yet the economic growth that had been sustained for thirty years since the end of the war was beginning to decline. Starting the 1960s, the growth rate of labor productivity went into a gradual decline, damaging profitability, and the two oil shocks of the 1970s brought the mass production-mass consumption economy to its knees. As the economic crisis deepened, social awareness was drawn away from resources and the environment. Interest shifted away from the importance of environmental issues to focus on economic problems, more specifically, unemployment and the search for new economic growth models.

Given these worldwide conditions, many firms, especially Japanese firms, channeled their technological development into process innovation, cut back on energy and materials per unit output and endeavored to increase labor productivity by reducing the volume of employment per unit output. Economic growth, albeit sluggish, did result in an expansion in output and sales volumes, but ultimately overall energy and natural resource consumption also increased.

Then the 1980s gave rise to the neo-liberalism movement in the United States and Britain, where the focus turned toward market competition, with the adoption of supply-side strategies being favored over demand-side strategies. Yet in that time the development of micro electronics had prompted the rapid adoption of information and communications technology in industry to cut costs and generate new markets. This was accompanied by increased networking between companies and markets. Piore and Sabel noted in the mid-1980s signs of a resurgence in network-based industry organizations, with coordinating roles as summarized in the three points cited earlier (Piore and Sabel 1984:265-272). So what happened to inter-company and market networks from the 1980s onwards?

Today there are countless semi-horizontal and semi-vertical inter-company networks that are based on information and communications technology, and companies are actively expanding their involvement in technology transfers, joint research, joint ventures and a variety of strategic alliances. These inter-company

networks have been developing gradually since the 1970s, but an examination of growth patterns in the 1980s has identified two specific patterns.

The first pattern was the case in which inter-company networks spanned a number of countries. This pattern closely resembled that of semi-vertical networks. Strategically critical sectors like planning, research and development and finance were concentrated in major cities throughout North America, Asia and Western Europe, and manufacturing and sales sectors operated in various forms, either as subsidiaries or joint ventures with majority ownership by the parent company, or through partnerships with other companies, and were scattered around the globe. Looking at companies that fit this pattern, we see that they have implemented comprehensive labor cost-cutting measures (with insecure employment and the transfer of production bases to developing countries), and have further separated their planning and operations divisions. In many cases, manufacturing processes with the greatest potential for causing environmental pollution have been transferred to developing nations with lax environmental regulations.

In the second pattern, inter-company networks were formed within a confined area, national economic zone or regional economic zone. Within specific economic zones, a major corporation would head up a semi-vertical network or a semi-horizontal network consisting of a number of companies. There were many examples of this network pattern in Germany, Sweden, Northern Italy and Japan. Under this pattern we additionally saw the formation of multi-faceted networks that also counted universities and local governments as participants. In Germany, Sweden, Denmark and other northern European nations, and especially in Japan, labor and management cooperated to improve quality and productivity, and cooperative relationships between companies, universities and local governments were formed and strengthened. Generally speaking, there was a very strong focus on both environmental protection and economic growth throughout Germany and Northern Europe, and this was probably not unrelated to the cooperative relationships that existed in these local industry networks.

These two inter-company networking patterns emerged with the increasing use of advanced technology and information networking in the 1980s. If we look at

the increased inter-company networking since the mid 1990s when the Internet entered the commercial arena, there seems to have been greater interaction and cross penetration between the two patterns. Networking today is characterized by the formation of diverse and complex global inter-company relationships through joint ventures, technical cooperation, original equipment manufacturing (OEM: products made under a partner's brand), and joint R&D. Companies consolidate their mutual advantages to promote innovation and to diversify their costs and risks, so as to be able to flexibly cater to a number of markets each with their own regional peculiarities. This kind of networking differs from the two networking patterns prevalent in the 1980s, but does incorporate elements of both.

1.3 The Emerging Digital Economy and the Paradigm Shift of the Market Structure

1.3.1 The Macroeconomic Significance of the Digital Economy

Since the mid-1990s there has been a push to create a massive global market built around the Internet. This is, in other words, the digital economy. America, Europe and Japan have been aggressively promoting the expansion of the digital economy, and as a result increasingly complex and diverse relationships are being formed on a global scale.

Looking back, up until around 1998 there was obvious skepticism about the effects of IT and the Internet on the economy. Christopher Freeman's comments (Freeman, C. 1992) are noteworthy in this regard. He pointed out that in most major OECD countries, the growth rate of labor productivity was exceptionally high in electronics industries such as computers and electronics components, and there was a significant boost in capital productivity as well. Yet, in most countries, the energy- and resource-intensive mass production paradigm still held the greatest weight across industry as a whole, which was dominated by corporate organizations, industrial regulations, social systems and infrastructure investment

designed for the mass-production paradigm. The new IT-based paradigm was not consistently present throughout the economy, and any spill-over effects were highly irregular. Even if individual companies were to actively introduce IT, corporate structures, social systems, industrial regulations and infrastructure were still geared to the old mass-production paradigm, which meant that the revolutionary capabilities of IT could not fully permeate the economy, and any impact on society was limited to specific areas.

However, information network upgrades, corporate organizational reforms to enable the effective use of IT, and reforms to social systems and industrial regulations to encompass new technological developments accelerated the shift away from what Freeman calls the old techno-economic paradigm towards a new one. The increased growth rate of labor productivity and the substantial boost in capital productivity seen in the IT industry represented quantum leaps that were to spread throughout the economy. Meanwhile, links in science, technology and R&D were encouraged, creating innovation chain reactions, which would bring about qualitative changes in the greater economic system and social system.

In the late 1990s, the IT industry and related sectors were the driving force behind the growth of the US economy. In 2000, however the inflated share prices that had underpinned that growth went into a freefall, and the US economy, that had until then been reliant on what were now recognized as over-valued high-tech share prices, looked set to enter a period of low growth. Yet there is no denying that the technological innovations that will have a significant impact on the economy in the decades to come are those knowledge-intensive innovations in IT, biotechnology and new materials. Research and development in these fields has become vital, with increasing fusion and integration between technologies in all industry sectors. And advanced Internet-based networks that link these same industry sectors will form the infrastructure critical to the growth of knowledge-intensive industry. Accordingly, we must envisage a framework in which we can use this paradigm as a foundation for environmentally-friendly sustainable development.

1.3.2 The Digital Economy and Creation of e-Marketplaces

The core of Internet business at present is business-to-business, or B2B as it is known. The scale of the B2B market is vastly different to that of the B2C (business to consumer) market. Upon closer inspection, electronics and IT-related products, or electronic component purchasing, have by far the largest market share. This is followed by auto parts procurement and construction. Initially B2B begins between specific companies with orders placed over the Internet with existing suppliers. Eventually, more and more parts suppliers from all around the world will be included and companies will be able to produce better products at low cost and procure parts by selecting companies that always deliver on time.

Thus, e-Marketplaces have a vital role to play. An e-Marketplace is an environment that can be accessed by companies anywhere, enabling orders to be placed and received over the Web. e-Marketplaces for automotive parts and electronic components are already in place around the world.

e-Marketplaces generally have four functions. The fundamental feature of current e-Marketplaces is (1) the use of an "aggregator" or "catalog" for transactions with fixed prices that is suitable for handling the sale of standard products between multiple buyers and sellers. While these transactions do indeed have a large share of the market, this function alone provides little incentive for new capital investment. Therefore, e-Marketplaces should also feature the following three functions along with the first: (2) seller-driven "auctions" for the trading of rare or used goods; (3) buyer-driven "reverse auctions" where multiple sellers compete to sell products; and (4) exchanges where custom-made goods with standard product specifications are traded under mutual conditions. In the future these four functions will be integrated into Web solutions that will enable one-stop processing via a browser. Integrating these functions is sure to make e-Marketplaces truly user friendly for both buyer and seller.

At present, the primary function of e-Marketplaces is the placing and receiving of orders, but in the future they will need to be linked to payment settlement networks. They will also need to provide insurance options, especially insurance

against damages or loss, and credit functions. Currently major companies mostly place orders with small and medium enterprises (SMEs) that receive those orders and supply the parts. Insufficient capital and poor capital liquidity are a potential problem for these SMEs. A bridging finance function will need to be incorporated. Currently, trading companies, non-banks and regional financial institutions provide bridging finance to SMEs, but this function is not available in e-Marketplaces. More and more e-Marketplaces now offering credit functions and distribution links are also important. If orders are processed over the Net, but distribution is not efficient, then this will greatly impair overall efficiency.

IT investment is essential for providing these functions, even if they are outsourced. Existing organizational structures need to be reviewed and business practices and industrial relations (labor-management relations) should be overhauled to stimulate this investment.

The IT revolution has not only had implications in the economic arena by changing company structures and behavior patterns, it has also affected people's lifestyles. Economic systems are going through sweeping changes on a global scale as they move toward a new economic order.

The full-scale implementation of B2C will take some time given the many system-related issues that need to be resolved on an international level, such as the systemization of electronic authentication and digital signatures, and the protection of personal information. But if we succeed in coordinating the systems of individual companies, then B2C will really take off. B2C is already making impressive inroads in certain sectors, including the automotive industry, computers, peripheral equipment and travel, and B2C is expected to post significant growth in the future in consulting, banking, insurance, securities, education, health care and other service sectors.

The nature of e-commerce generally means that the parties do not interact face-to-face, and as such, establishing trust in the market has become a major issue. This issue is even more crucial in B2C transactions, and the formation of Web-based communities that facilitate horizontal communication has come into focus. For example, by including functions for consumers to give their opinions

and exchange product or service evaluations, and by having the service provider respond promptly to any questions or reservations, businesses can boost the credibility of Web-based business, and at the same time bolster the credibility of businesses that advertise on the Web, and provide useful market information. This will also work to improve investor evaluations. Reliable third-party checks must be incorporated to provide such a place for doing business, which means that elements external to the market will have to be introduced.

Now that we have described the international climate for the digital economy, we next look at the significance of information networks in sustainable development based on global environmental protection, the major issue of the twenty-first century, and exmine information networks in relation to industrial organizations and the governance of local communities. As explained by von Weizsacker (1992), information technology can be applied to environmental issues. In the first place, it can be used to accurately monitor and analyze ongoing compound environmental degradation. Also, information technology can make it possible to tailor production to adapt to fluctuations in demand. It can also facilitate advanced quality and inventory control, which in turn can lead to the more efficient utilization of energy and resources. In other words, information technology can improve energy productivity (gross domestic product per kilojoule). Moreover, systematic upgrades of urban transport facilities, telecommuting (working from home) and videoconferencing can all work to reduce the volume of traffic, attenuating air pollution. Yet it must be noted that there is no guarantee that the growth of the digital economy, which grew out of the IT boom, will be consistent with sustainable development. Therefore, the next section will focus on how we should integrate the digital economy and sustainable development, and provide a vision for future society.