Taming the Hydra: The Impact of ICT in the Asia Pacific

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I. Introduction

The information and communications technology (ICT) revolution began in the early 1990s and has swept the world, the Asia Pacific included. From Hanoi to Hong Kong, it is uncommon for the average person to be unaware of the impact felt by the pervasiveness of cell phones, computers and the Internet. Indeed, the popular press has begun to acknowledge the existence of a 'New Economy' – one marked by rapid increases in productivity and growth with minimal inflation pressures – due to the enabling nature of ICT. Computers have progressed so quickly that complex tasks, tools and lifestyles once the domain of governments, corporations or wealthy individuals have now become available to the common man on the street. It is also this rapid pace of change that has sent policymakers and academics scrambling to distil the myriad influences and impacts of ICT.

Although this has increasingly been challenged by recent developments, such as the downturn of the global economic cycle and the onset of global recession led by the world's three largest economies of the United States, Japan and Germany has led many to reconsider the resilience of the ICT revolution. Although the voices of naysayers have rung louder in recent past, the sustainability of the impact due to the New Economy is likely to remain, although these changes should be likened more to glacial diffusion rather than volcanic re-definitions.

This paper will address the manifold impacts of ICT, and in particular, its impact on economies and societies in the Asia Pacific region. This is no small task, but the paper will endeavour to provide a broad overview, coupled with critique and analysis, of the various economic, political, and sociological consequences of this revolution. Specifically, the dearth of research in the political and social areas necessitates that the paper's focus be biased towards these latter two issues. As such, the paper seeks to redress what has so commonly been accepted as secondary in mainstream discussions in the literature, and it is our belief that these impacts are of enough significance to warrant careful study.

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[*] Institute of Southeast Asian Studies. The authors wish to thank participants of the APAP Cebu conference, in particular Chia Siow Yue and Simon Tay, for invaluable input. The usual disclaimers apply, and all remaining errors are our own.

The paper will proceed as follows. After this introduction, section II provides a review of the ICT revolution in the Asia Pacific, focussing on several relevant factors that are of interest to the study. Section III continues by discussing in turn the various influences that ICT has had on economies and societies, under the broad headings of the economic, political, and social impacts. Inter-weaved in this discussion would be how these more general concerns relate specifically to the countries of the Asia Pacific, especially from a policy perspective. A final section concludes.

II. The ICT Revolution in the Asia Pacific[1]

The impact of ICT in the Asia Pacific is varied and complex. However, as with the general theme of the papers in this volume, it is hypothesised that post-crisis Asia will feature a divergence in the growth paths of ICT development in the region. Such a scenario is perfectly credible – given the limited resources available after the Asian financial crisis, countries that are less developed will likely scale back on ICT investment in order to realign priorities; whereas those that have an already developed ICT landscape will take the opportunity to forge ahead in order to reap the full benefits of a mature ICT infrastructure.

This has been further expedited by the global slump in electronics goods, causing those nations who have yet to engage in ICT production and diffusion to reconsider their policies, and allowing those who have such policy in place to take advantage of lower export demand and hence prices to upgrade and enhance their existing infrastructure. This section paints a broad-brush picture of the ICT landscape in the Asia Pacific countries, looking at the levels of development in ICT infrastructure, Internet and e-commerce activity, hardware and software production, ICT diffusion, the ICT labour market, and the legal and policy environment for ICT. The discussion will proceed by segregating the countries into several (admittedly) artificial groups: the Newly Industrialising Economies (NIEs), the developing countries, and the transition economies.[2] Japan and the Oceania nations of Australia and New Zealand, as

[1] This section draws heavily from a previous work that discussed the ICT landscape in APEC countries (Chia & Lim 2001).

[2] The NIEs consist of Hong Kong, Singapore, South Korea, and Taiwan. The developing economies comprise Indonesia, Malaysia, the Philippines, Thailand, and Brunei. The transition economies are Cambodia, Laos, Myanmar, and Vietnam (CLMV).

industrialised nations, and China, as the potentially largest market in Asia, are treated separately.[3]

ICT Infrastructure as Building Blocks for the Information Revolution

For the purposes of this paper, the telecommunications infrastructure refers to the levels of telephone penetration (teledensity) – both fixed line as well as mobile – and the extent to which Internet service provision is available. Specific technologies – such as T1/T3 lines, ADSL and ISDN – will be discussed only where relevant. Furthermore, major telecommunications providers are highlighted when they help concretise concepts and examples. In terms of IT infrastructure, the common benchmark applied is the extent of PC usage in the population.[4] The primary focus will be on physical infrastructure, with non-physical factors such as policy and legal issues left to the 'ICT environment' subsection. The importance of an adequate telecommunications infrastructure cannot be overemphasised – telecommunications form the prerequisite backbone for many other forms of ICT, and in the absence of proper networks, advanced ICT such as the Internet simply cannot be deployed.

In general, the telecommunications infrastructures of the Asia Pacific countries range from a moderate level of development to being highly developed. Japan and Oceania, evidently, display very mature levels of telecommunications infrastructure development, although the NIEs are on par, and in many cases exceed, that of these nations. With some notable exceptions, the economies of developing Asia have less developed infrastructures. The teledensity of China is somewhat difficult to evaluate, as major cities such as Beijing and Shanghai possess developed infrastructures, although rural areas are very poorly connected. For personal computer diffusion, this variance between nations is magnified – in some countries, there are computers for every other person, whilst in others, computers are virtually absent.

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[3] A detailed discussion of the position of ICT development in East Asia vis-à-vis the other major economic regions of the world is beyond the scope of this paper. It is sufficient to state that East Asia stands at the forefront in terms of ICT production (especially hardware, but to a lesser extent in software as well), but lags in the areas of ICT diffusion in general, although the NIEs are the exception in this final respect. The interested reader is referred to Dedrick & Kraemer (1998).

[4] Unfortunately, this inevitably ignores quality differences in terms of processor speed, graphics adaptor technology, and hard disk size, among others. Nonetheless, such latent specifics are not of foremost importance at the macro level and can safely be aggregated into the PC diffusion statistic.

The NIEs all display a high level of telephone penetration. For 1999, the teledensity in Hong Kong was the highest in the group, exceeding 57 lines per 100 people, with that in Korea being the lowest, at slightly more than 44 lines per 100 people. Nonetheless, as a group, fixed line density is very high, averaging about 51 lines per 100 people. This high teledensity is also reflected in mobile cellular subscriber figures, with the group average being about 52 lines per 100 people (ITU 2000). Most of these economies are in the process of implementing, or already employ, advanced digital technologies such as ADSL and ISDN. In the main, telecommunications firms tend to operate in a competitive environment, although there tend to be a few dominant players – and more often than not, this would be the former state monopoly provider. For example, in Taiwan, the Chung-Hwa Telecommunications Company is dominant, whilst in Korea, the Korea Telecommunications Authority is the leading provider. PC penetration rates in these economies are also high; the group average being about 48 PCs per 100 people. For Singapore, the economy with the highest rate of diffusion (61 per 100), a recent study has estimated that 23 per cent of homes had more than one PC in 2000 (Dawson 2001).

Japan and Oceania have modest but very respectable rates, with about half the people having access to fixed lines although mobile access was less pronounced (cellular teledensity is 45 in Japan but averages 25 in Oceania) (ITU 2000). Telecommunications technology in these countries are advanced, and especially so in major urban centres such as Tokyo, Sydney and Auckland. In terms of telecom providers, all three nations possess an oligopolistic market structure; for example, Nippon Telegraph and Telecoms (NTT) and Telstra are the major providers in Japan and Australia, respectively. PC penetration in these countries is inferior to that of telecommunications penetration, averaging about 20 PCs per 100 persons.

In developing Asia, teledensity for fixed lines is low. The average amongst the 7 countries is only slightly more than 9 lines per 100 people, although the variation between countries is wide: Brunei, with the highest teledensity, has almost 25 lines per 100 people, whilst Indonesia, with the lowest, has only 3 lines per 100 people. Similarly, China has a low teledensities of 9 per 100 people (ITU 2000). However, as alluded to earlier, urban areas display very different statistics. For example, teledensity in urban areas of China is estimated to be as high as 28 per 100. Mobile communications are still in the nascent stages in developing Asia, with many countries having densities below 5, although some countries, notably Malaysia and Brunei, have slightly higher ratios (ITU 2000). Communication technologies vary widely between countries. Malaysia, for example, introduced T1 and ISDN in 1996 (National Trade Data Bank and Economic Bulletin Board 1996), whereas the Philippines only decided to build a new multi-service switching backbone network in late

1999 (Cisco Systems 1999). China is rapidly catching up in introducing new technologies: it has recently begun to expand ADSL, ISDN and broadband projects (Gesteland 1999). In most of these nations, former state telecoms providers remain the dominant players. For example, China Telecom maintains 95 per cent of the Chinese market, and PT.Telekom has exclusive rights to the provision of domestic telecommunications services in Indonesia through till 2010. For PC penetration, rates hover between 6 per cent (Malaysia) and slightly less than 1 per cent (Indonesia). In China, although the raw figures for PC diffusion are low, access to PCs are higher mainly because of access through work (37%) or Internet cafes (11%), although the majority of these (78%) are below the age of 30 (CNNIC 2000)

The situation in the CLMV countries tends to be extremely poor. With the exception of Vietnam (2.6 fixed, 0.2 mobile per 100 people), the others have with poor line densities and backward technologies (the average for the group is about 1 fixed and 0.2 mobile). Telephone access, if available at all, usually has to be effected through the government. There is a similar dismal situation with PC penetration, with PCs being little more than entirely absent (with, again, Vietnam as exception).

Internet and E-commerce Activity: Key Measures of ICT Diffusion

The status of electronic commerce displays a wide variation across countries, not least because standardised measures of e-commerce activity do not exist. Increasingly, however, e-commerce activity is becoming centred on Internet-based commercial exchange. This subsection will provide brief overviews of Internet activity in the various regions, together with discussions of e-commerce activity. Where they contribute to the discussion, values of e-commerce transactions are provided. A caveat needs to be made here: as valuations of e-commerce activity can vary widely, mainly due to different methodologies being applied (Buckley and Montes 2001), it is important not to place too much emphasis on raw figures but rather view the overall picture more in terms of ordinal, rather than cardinal, rankings.

Overall, Internet and e-commerce activity in the Asia Pacific countries falls into a range from extensive to non-existent. For many of these nations, Internet activity has been a recent phenomenon, although growth has been exponential in many cases. Where Internet access is available, most countries enjoy a liberalised Internet Service Provider (ISP) market, with multiple gateways of entry into the Internet. Although Japan is the undisputed leader in terms

of number of Internet hosts,[5] countries such as China and Taiwan are rapidly catching up. E-commerce activity, however, remains high only in Japan, and in spite of potential, remains a small part of the other countries' economies.

Japan's number of hosts clearly engulfs that of the other nations – 6,081,390 as of May 2001. the average between the 3 countries is slightly more than 30 million hosts (Netsizer 2001).[6] Unfortunately, high telephone and Internet access fees are high – a reflection of the high costs of living in the country. E-commerce spending levels of US$27.3 billion account for 70 per cent of all Asian e-commerce (eMarketer 2001). B2B tends to dominate online e-commerce transactions – a trend that is not uncommon, even in developed countries. The Oceania group has an average of about 1.1 million hosts (Netsizer 2001), and access rates tend to be affordable – unlimited access in New Zealand by Xtra, the market leader, costs approximately US$10 a month.

Following closely behind the developed nations, the NIEs have an average of 787,000 hosts between them. Amongst them, Taiwan has slightly more than 1.5 million hosts, and is ranked eighth in the world in terms of host number; Singapore has the smallest number of hosts at 276,000 (Netsizer 2001). More pertinent to these economies (due to their differing populations) are the Internet penetration rates: here, Singapore and Hong Kong have the highest penetration rates of 48 per cent, and Korea and Taiwan have rates of 35 and 29 per cent, respectively (Nua Internet Surveys 2000). Due to freely competitive ISP markets in the NIEs, costs of access are affordable. Taiwan, due to a broadband price war in 2000, lowered access fees, so that monthly charges for ADSL collapsed; for example, on HiNet, the largest ISP, access per month is only US$18. E-commerce in the NIEs involves both Internet-based e-commerce as well as the proprietary electronic data interchange (EDI) networks. Singapore, for example, has the TradeNet EDI system, which facilitates electronic B2B transactions (Teo & Lim 1998). In general, B2B features more prominently than B2C, although market sizes for both are still relatively small – contrast Korea's market size of won61.4 billion (US$47.3 million) to Japan's far larger US$27.3 billion.

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[5] It is important to note here that the number of Internet hosts is not necessarily indicative of the depth of penetration of the Internet in a country. The U.S., in particular, has a very large number of hosts, but many U.S.-based commercial hosting sites provide services to users not based in America – a testimony to the borderless nature of service provision on the Internet.

[6] This is second only to the U.S. (78,484,100 hosts) worldwide, and is followed by Canada with 5,602,150 hosts.

In contrast, the number of hosts for developing Asia is small. Thailand has about 67,600 hosts, and the Philippines possesses about half that number, 34,400 (Netsizer 2001). The group's e-commerce activity is still small, although it is rapidly growing. The average e-commerce revenue for the group in 2000, excluding Brunei,[7] was about US$1.1 billion. However, the countries displayed differential rates of growth, with Indonesia having the slowest rates of e-commerce growth, while Malaysia enjoys e-commerce revenue totalling US$2.6 billion in 2000, more than twice the group average (Stat USA 2001).

In China, there were approximately 126,600 hosts as of 2001 (Netsizer 2001). Access charges tend to be prohibitive, despite the competitive environment that purportedly exists in the ISP market (China has 16 ISPs). For example, ChinaNet charges US$73 for 40 hours' access per month – above the US$60 monthly average wage. The e-commerce scene is still in their early stages, as e-commerce in China began only in 1997.

The transition economies have largely been left behind by the Internet revolution. The only outstanding statistic amongst transition economies comes from Vietnam. Still, with access charges of US$20 a month (relative to an average per capita income of US$50) and poor service quality by the Vietnam Datacommunication Company (VDC)[8], this is little comfort.

Nuts and Bolts: Hardware and Software Production in the Asia Pacific

Hardware production refers to the production of ICT goods, which includes components such as integrated circuits (ICs) and memory chips, electronic equipment such as cellular telephones and personal digital assistants (PDAs), and accessories and peripherals such as printers, scanners, and modems. Software production generally involves the production of applications (both generic and proprietary), together with systems development, database programming, and Web/multimedia content design and development. Market sizes are discussed where such figures are deemed useful for illustrative purposes.

The NIEs, together with some of the countries in developing Asia (especially Malaysia and the Philippines), are major world manufacturers and exporters of ICT hardware. However, each economy tends to maintain its own area of specialisation. Taiwan has very strong notebook PC, motherboard, scanner and casing industries, *inter alia*. In motherboard

[7] Due to unavailability of statistics.

[8] The VDC is the sole backbone network provider in Vietnam. It is a state-owned company managed by the government through Vietnam Posts and Telecommunications (VNPT).

production, for example, Taiwan accounts for 79 per cent of world output; and in semiconductor equipment, the Taiwanese market is estimated at US$9.78 billion in 2000, second only to the U.S. at the global level. Similarly, Singapore's comparative advantage is in hard disk drives, Korea in memory chips, and Hong Kong in semiconductors and ICs (Low 2000). Although the traditional strength of the NIEs has been in its hardware industry, there has been a growing consciousness concerning the importance of the software sector. As such, efforts have been directed towards expanding the industry. These efforts appear to have paid off. In 2000, Korea is projected to have a US$9.3 billion software industry, up from US$6.6 billion in 1999 and US$5.7 billion in 1998 (Hong 2001). Although at a somewhat slower pace, the other NIEs are also stressing software development capabilities.

For developing Asia, only the Philippines and Malaysia have significant software export bases in hardware and software. In 1998, export values of electronics from the Philippines and Malaysia were valued at US$18.55 and US$12.9 billion, respectively. Recently, the Philippines has also moved to exploit their proficiency in English and their ability in programming; this has provided a boost to the software industry there, and exports of software in 2000 are targeted at US$300 million (NITC 1997). Interestingly, software development in Thailand has also increased in recent times – its monetary value touched US$204 million in 1999. The other countries of developing Asia have small ICT goods and services sectors. The transition economies have little or no hardware production to speak of, although this is rapidly changing in Vietnam (Asia Times 2001).

The developed economies have largely moved towards consumption, as opposed to production, of ICT hardware. However, Japan remains a market leader for high-technology electronics and innovation, and with its strong research-oriented universities, Australia and New Zealand have also been involved in software and technology development, although niches do exist in hardware production – an example being KRONE, a firm providing high-speed data connectivity solutions.

In sum, hardware production in the region is strong in most cases, albeit in different products and components. Software production is clearly increasing, although only Japan and the Philippines have established strong bases in their respective economies. Hence, the pattern for hardware and software production mirrors that of ICT infrastructure and Internet and e-commerce activity – with the NIEs, Malaysia, Thailand, and Japan having clear production fronts, and the other economies having little or no major production concentration.

ICT Labour Markets – The Human Resource Paradigm

On the supply side, the ICT labour market is influenced first by the literacy rate – especially English language ability, coupled with primary and secondary education in mathematics and science – as well as higher education in technical and computer-related areas. Beyond educational preparation, however, it is also necessary to examine the demand-side strength of markets for ICT manpower; in this respect, an overview of ICT professionals in terms of various statistical indicators,[9] together with employment statistics, will provide a fuller picture of the ICT labour market in the various economies.

In some senses, therefore, the ICT manpower in China and Japan represent two different ends of the spectrum. China's literacy level of 80 per cent falls far short of Japan's almost 99 per cent. With advanced research and development (R&D) capabilities, Japanese ICT workers are also engaged in production activities that are higher in the value chain, compared to the overwhelming majority of ICT workers in China whom are engaged in low-skilled, labour-intensive assembly and production. With a large part of Japanese ICT professionals drawing annual incomes of between US$44,000 and $87,000, remuneration clearly eclipses that of Chinese workers. However, it is important to keep in mind the far larger base that China has – for example, there are an estimated 872,000 workers involved in producing ICT connectors, cable assemblies and backplanes alone (Fleck Research 2000).

In the NIEs, the high literacy that have characterised their Tiger economies have been rapidly adapted to cope with the increasing demand for a high-technology, ICT-trained workforce. Literacy rates – variously defined but generally based on the definition of an individual aged 15 and above with reading and writing ability – is in the excess of 90 per cent. Most citizens have a working knowledge of the English language, with English either taught widely in schools (Korea, Taiwan), used as the primary medium of instruction (Singapore), or widely used in government and business (Hong Kong). Furthermore, most have an admirable proportion of population having been education up till tertiary level; Taiwan, for example, has a 31 per cent college graduate ratio, and has produced roughly 20,000 technology professionals every year since 1996. Remuneration tends to be on the high side – a reflection of the increasing shift away from low-skilled ICT goods production towards high-skilled ICT services. In Korea, the average monthly wage for the telecommunications sector is 2,104,646 won (Korea Information Society Development Institute 1996), compared to the industrial

[9] These indicators include profiles of ICT professionals built from the nature and type of ICT job, salary levels, educational attainment, and years of ICT-related work experience.

average of 1,426,797 won (National Statistical Office of Korea 2000). All four do not experience significant 'brain drain' problems, with Korea and Taiwan enjoying a reverse brain drain and Hong Kong and Singapore being a net importer of ICT talent. In some senses, the Oceania economies approximate the situation in the NIEs (with respect to ICT workforce), although the markets in these countries for ICT manpower somewhat smaller. Australia, for example, around 235,000 Australians (or 2.7 per cent of the workforce) are employed in ICT-producing industries. These jobs are higher paying than most: AU$51,243 per annum, compared to the average of AU$29,409 in 1998-99 (Houghton 2001).

The workforce trend in developing Asia displays a lower level of literacy – the average for the 5 countries was 88.8 per cent[10] – although levels are appreciable nonetheless. However, English skills tend to be weaker amongst these countries, as compared to the NIEs. With the exception of the Philippines and Malaysia, however, ICT professionals are small in number. Contrast Malaysia's estimated 50,000 software professionals (0.6% of workforce) with Thailand's estimated shortfall of 150,000; or the Philippines' 357 computer schools, colleges and training centres (NITC 1997) to the ICT training facilities in Brunei that are limited primarily to universities. Due to generally lower labour costs, compensation to ICT professionals are competitive; for example, the majority (78.3%) of ICT labour in Indonesia is paid under US$5,000 annually (SEARCC 2001). The brain drain problem is especially acute in these countries (notably in the Philippines and Thailand), as skilled workers often migrate to either the U.S. or nearby Singapore and Japan in order to earn higher wages.[11]

The situation in the transition economies is generally poor. Effective literacy rates are approximately 30 per cent (with the exception of Vietnam, which has a high literacy rate of 93.7%), and the group average for public expenditures on education in 1997 was 2.3 per cent of GDP (World Development Report 2000). Even for Vietnam, the most ICT-advanced economy of the group, attempting to translate science and technology education (S&T) into ICT and economic development has been a struggle, primarily due to its weak ICT infrastructural support (Levinson 2000). This is aggravated by the poor quality of training that ICT graduates often receive (Saigon Economic Times 2000). As in the case of the developing Asian countries, there is a brain drain problem, although the incomplete integration of the

[10] The mean has been somewhat inflated by the Philippines' high literacy rate of 94.6%.

[11] The movement of ICT professionals in particular is a special case of the more general migration trends in the region, which are discussed in detail in the paper by Yu, elsewhere in this volume.

CLMV economies into ASEAN has limited the employment and education prospects of ICT workers from these countries.

Nature or Nurture? Getting the ICT Environment Right

The environment for ICT growth is dependent on, although not limited to, government policy in ICT and ICT development – in particular, national information infrastructure (NII) building programmes and national innovation systems (NIS). Other important aspects include the regulatory environment, especially in the telecommunications industry (as was discussed earlier), and the legal environment. Detailed discussions of each country's ICT policies would be a voluminous task,[12] and it is proposed that this discourse be limited to general trends for the respective groups, as opposed to a detailed study. However, it is in this respect that distinct differences in approach and philosophy may be drawn even from within the various groups.

The NIEs – together with Japan and Oceania – again tend to exhibit greater pro-activity in seeking to formulate a coherent strategy for ICT development, although their specific approaches differ. In terms of R&D and S&T policy, Korea has emphasised a large-firm internalisation model through its *chaebol* conglomerates, Taiwan a small and medium enterprise (SME)-led innovation network model, and Singapore a model that leverages foreign direct investment (FDI) through multinational corporations (MNCs) (Wong 1999). Even the Hong Kong administration, once the paragon of *laissez-faire* capitalism, has begun investment efforts in R&D.[13] Similarly, the NIEs also have targeted NII plans. For example, Hong Kong and Singapore have drawn up the 'Digital 21' IT strategy and the 'ICT 21' master plan, respectively. Japan has a Global Information Infrastructure plan that aims to implement a nationwide optical fibre network by 2010. The legal and regulatory environments for the NIEs also tend to be pro-business in general, with adequate respect for and enforcement of intellectual property (IP) rights, resulting in an average piracy level of 54% in 2000 (IPRC

[12] And one better left to more complete studies. See, for example, Chia & Lim (forthcoming).

[13] The idea of an Applied Science and Technology Research Institute (ASTRI) was announced by the Chief Executive in 1998, and in 2000, the Hong Kong ASTRI Company was tasked with the responsibility of planning and developing the institute. The ASTRI's aims are to support midstream research and development, enhance Hong Kong's technological human resources development; be a focal point for attracting outside research and development personnel to work in Hong Kong; act as a spawning ground for technology entrepreneurs; promote greater application of technology in industry; and provide a focal point for industry-university collaboration (ITC 2001).

2001) – a decent rate, but certainly short of Western standards that average 30%. In this area, the developed nations have been the most successful. For example, Japan has managed to dramatically reduce its piracy levels from 55% in 1995 to 37% in 2000 (IPRC 2001), together with recent amendments to the Patent, Trademark and Copyright Laws have served to re-establish Japan's commitment to an ICT-friendly legal framework.[14]

Developing Asia, although relative latecomers to developing a positive ICT environment, efforts have been rapid, and many countries already have blueprints for NIIs. The Philippines introduced its first National Information Technology Plan in 1994, and in 1996 Malaysia will embark on its ambitious Vision 2020 plan – together with its hallmark Multimedia Super Corridor (MSC) – to transform its economy into a knowledge-rich one. NIS efforts, however, tend to be more muted in the group, owing principally to smaller ratios of researchers, scientists and engineers (RSEs), a stronger focus on ICT infrastructure development, and the absence of comparative advantage in R&D. Furthermore, higher levels of piracy (averaging 74%, excluding Brunei) undermine incentives for software development (IPRC 2001), although developments from 1995 onwards have led to greater conformity of IP laws to international standards. Still, enforcement in these countries tend to be weak. The Chinese government has also engaged in several major ICT initiatives,[15] many of which are patterned after those adopted by the NIEs and more ICT-advanced developing Asian countries. Although there is are well-developed IP laws in place, enforcement has been extremely poor, with conflicts arising from issues as diverse as cyber-squatting to software counterfeiting. Reducing the piracy rate from the present 94% (IPRC 2001) may prove to be a more complex problem then might first appear.[16] This situation deteriorates dramatically for the transition economies, where there are generally no NIS policies, or even when they exist, they are often resolutions with little detailed, concrete measures. Piracy is rampant – Vietnam's piracy is 97

[14] In fact, the Japanese Ministry of International Trade and Industry is currently considering an entirely new 'Intellectual Property Basic Law', which will set a framework within which the government will form comprehensive policies for patent, trademark, and copyright matters.

[15] The major programs are the 836 Project, a funding programme that assists R&D projects in ICT as well as ICT enterprises, and the Torch Program, an initiative that seeks to commercialise discoveries made by the universities and government research institutes. Other policies include strategic master plans, high-technology industrial zones, R&D tax incentives, and public funding for venture capital.

[16] This stems from the nature of Chinese culture and its emphasis on sharing, the high demand for pirated software, absence of public awareness and the associated style of education, the attitude of software manufacturers, and the underdeveloped local software industry (Ho 1995; Kay & Scott 2000; Wingrove 1995).

per cent (IPRC 2001) – and although national R&D centres exist, they often carry the baggage of the socialist system.[17]

III. The Multi-Faceted Influences of ICT

The ICT revolution has challenged traditional thinking in economics, and, to a lesser extent, in political and social theory. It is therefore useful to briefly review the central theories and concepts that have arisen in the study of the information or knowledge-based economy, of which ICT is the key driver. To a limited extent, some of these issues have been empirically tested in various contexts, both at country and industry level, although conclusions have been far from concrete. They include challenges that arise from technological advancement, the economics of networks and information, the impact on social development, the digital divide, changing government-people dynamics, and the effect of ICT on culture and values.

On Technological Advancements and Productivity Paradoxes

Conventional economic theory has long trumpeted the importance of technological advancement as a source of economic growth. Earlier work has generally treated technology as an exogenous force. However, though elegant, the persistence of disparities between the growth of economies over time meant that this view of the world was increasingly at odds with empirical evidence about the response of economies to technological change. Moreover, treating technology shocks as a 'black box' effectively isolated the contribution of technology as a key driver of growth. In order to reconcile these contradictions, and to afford more insight into the central role of technology, new growth theory was developed to formally model the endogeneity of technological progress, mainly through either process innovation or human capital augmentation, in the process of growth. Endogenous growth theory has also led to the justification of government intervention in the provision of technology, given its nature as a public good.[18]

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[17] Specifically, they tend to produce research that is channelled towards planning and control in support of the existing regime and are seldom effected for the populace. Moreover, there is little interaction between these institutions with private enterprise, in contrast to the active bridging role that public research centres and institutions play in the NIEs, Japan, and other developed economies.

[18] The former neo-classical growth theory is best exemplified in the growth model of Solow (1956); the latter, by the works of Romer (1986) and Grossman & Helpman (1991).

A primary motivator for investment in ICT has been the positive effects of increases in total factor productivity that ICT engenders; in particular, the beneficial effects of ICT on the productivity of labour and capital. However, despite the large investment in ICT between the 1970s through till the mid-1990s, there were little perceptible gains in terms of productivity – a phenomenon that subsequently came to be known as the Solow (1987) 'productivity paradox'.[19]

However, from the mid-1990s onward, a series of papers established positive returns to ICT in the United States (Brynjolfsson & Hitt 1996; Oliner & Sichel 2000), European countries such as Finland (Niininen 2001), the OECD (Calderón 2001; Schreyer 2000), and even newly industrializing economies such as Korea (Jeong, Oh & Shin 2001) and Singapore (Wong 2000). The record for developing countries, however, was less promising (Dewan & Kraemer 2000), although the feeling was that realized gains were only a matter of time. Studies rushed to explain the paradox, with the most persuasive hypotheses being: first, that technological advances require a period of diffusion before productivity is influenced – resulting in the lag; second, that the productivity benefits of ICT has been limited to gains in the ICT manufacturing industry itself, not the wider economy; and third, that measurement issues cloud the true contribution of ICT to productivity.[20]

Recent thinking, however, has increasingly called to question the assumption of returns to investment in ICT. In a sharp response to the turbulence of high-technology markets in 2000/2001, voices in the business community (Madrick 2001), academics (Gordon 1999; Krugman 1997) and even consumers (Economist 2001) have become more vociferous in criticising the sustainability of the alleged gains in productivity. More importantly, these critiques may lead to concerns that Asia Pacific countries that have been so deeply enthusiastic in embracing the technology revolution may find themselves caught in a host of excessive and inappropriate ICT investments. Indeed, this central concern is exacerbated by the nature of general purpose technologies.[21]

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[19] Solow stated in a 1987 New York Times book review that "…we see the computer age everywhere but in the productivity statistics". The paradox was not limited to the U.S., but was widespread in both the industrialized nations as well as the developing nations.

[20] Triplett (1998) discusses these explanations, and several more, in his very informative paper.

[21] General purpose technologies (GPTs) refer to technological advancements characterised by pervasiveness in use and complementarities with production and consumption use, leading to sustained and pervasive productivity gains. Examples of GPTs are the dynamo, electricity, and, especially relevant to this paper, ICT.

As illustrated in a typical case in the literature,[22] the introduction of a major new technology in an economy generates a cycle consisting of two distinct phases. The first – aptly called a time to sow – involves the diversion of resources into developing complementary inputs that utilise this new technology. Consequently, output and productivity fall, as they are channelled towards this task. When the time to reap arrives in the second phase, enough complementary inputs will have been developed, and it becomes worthwhile to harness the advantages of manufacturing using this new technology. As a result, output, wages and profits rise. Extensions of this case to an open economy (Chung 2000) show that when a developed country (the North) engages in the first phase of the cycle, developing nations (the South) will enjoy a temporary boom. This ends in the second phase, when the North completes its R&D processes and re-asserts its lost competitiveness.[23]

Translating theory to reality, it is possible to envision that the period between the 1980s and first half of the 1990s – the period of the productivity paradox – was possibly the gestation period for ICT in the industrialised economies. From the mid-1990s onwards, the productivity surge in both the U.S. as well as the E.U. suggests the maturation of these developed nations into the second phase. This implies two things. First, the Asian miracle – fuelled by the electronics boom – may well be at ebb. This is a serious outcome, and would imply an urgent need for economies to leverage the ICT revolution in propelling themselves to developed nation status, as well as to actively pursue R&D as well as S&T programmes. Second, countries that have been left behind will find the catch-up game far more difficult to play. This suggests that developing Asia and the transition economies, already clearly lagging in the information economy, will need to rapidly and actively engage in ICT diffusion and R&D if they are to bridge the existing technological chasm, or risk being left even further behind.

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[22] Helpman & Trajtenberg (1998a, b), as well as the other contributions in the Helpman (1998) volume, remain the seminal work in the field for the closed economy context. Formal studies in an open economy context have been limited. Chung (2000) and Beaudry & Green (2001) provide two examples.

[23] The limitation here is that the open-economy model explicitly assumes that, due to comparative advantage, R&D only takes place in the North. Whilst this is evidently an oversimplification of the true state of affairs, the results of the model are likely to hold without loss of generality so long as the North's R&D levels far outstrip that of the South. The statistics concur with this finding: as alluded to in Section II, relatively little R&D takes place in East Asia outside of Japan and the NIEs.

The Economics of Networks and Information

A major problem that afflicts economic systems is the presence of incomplete, or asymmetric, information. Asymmetric information occurs at a microeconomic level in both consumer and producer markets,[24] as well as at a macroeconomic level between economies engaged in cross-border transactions. The promise of ICT has been its unique ability to enhance informational flows, thereby correcting deficiencies in information that might lead to inefficiencies or a failure in the market mechanism. Reinforcing this are the benefits that accrue through network externalities – which are the economic gains that arise when users of a particular technology attain a critical mass.[25] Therefore, network externalities and the elimination of asymmetric information form two pillars that give rise to an entirely new field in economics – that of the study of networks and information.[26] These fields, in turn, have led to a re-examination of traditional modes of business to the economics associated with electronic commerce (e-commerce) and weightless goods.[27]

The economics of e-commerce can be decomposed into three major areas. First, due to low marginal costs of production and distribution coupled with high initial fixed costs, production and value chains are changed, requiring businesses to develop new models of pricing and distribution. Second, weightless goods tend to yield increasing returns both in scale and scope due to production efficiencies and product complementarity. Third, e-commerce exerts influences on market structure, generally by promoting competition and market creation through mediums such as online auctions and electronic exchanges. The stiffer competition is likely to create incentives for firms to differentiate their products in order to maintain profits,

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[24] The classic examples for both are, respectively, the secondary motor-vehicle market (Akerlof 1970) and the insurance market (Rees 1989).

[25] For example, consider the case where the fax machine is first employed in the Asia Pacific. A single machine in Singapore is of virtually no use, while two faxes, one in Singapore and one in Malaysia, afford instant connectivity between the two nations, and four faxes, in Singapore, Malaysia, Korea and Hong Kong open up an entire new permutation of interactions.

[26] Some authors treat these two strands of the literature separately, although there is a great deal of overlap. For the purposes of this paper, which is not to examine specific areas in either school but to examine the impact of the body of theoretical work on economies through the medium of ICT, the treatment will draw liberally from either strand. More on network and information economics can be found at http://www.stern.nyu.edu/networks/site.html and http://www.sims.berkeley.edu/resources/infoecon, respectively.

[27] Choi, Whinston & Stahl (1997) and Shapiro & Varian (1998) are the standard references for the economics of e-commerce and the network economy.

as well as limit their ability to extract consumer surplus through exercising price discrimination. On balance, therefore, e-commerce is expected to lead to improved production processes and greater consumer sovereignty.

Possibly the most practical application of e-commerce is in the establishment of electronic marketplaces. These include older electronic exchanges such as proprietary Electronic Data Interchange (EDI) networks, as well as Internet-based business-to-business (B2B), business-to-consumer (B2C) and consumer-to-consumer (C2C) portals.[28] Although such e-markets are unlikely to completely displace the more traditional methods of exchange, especially in the B2C and C2C areas, there is some evidence[29] that businesses are increasingly seeking to conduct their transactions online due to significant cost savings.[30]

In the Asia Pacific economies, this means challenges to both consumers and producers: consumers require a change in their current mindset regarding buying and selling electronically, whilst producers need to work to ensure the security and privacy of online transactions. Although e-commerce has not led to the overnight dis-intermediation of the middleman, the complete revamping of businesses, or the end of the shopping experience (so prized in Asia), it will, in time, nonetheless integrate into business practices and personal lifestyles. Governments have a role to play by expediting the spread of e-commerce through actively integrating ICT into their online procurement procedures (B2G) and their provision of public services (G2C). Indeed, countries such as Singapore and Thailand have been active in the spread of e-government (IDA 2000; NITC 2000). The Chinese market will also be important, primarily due to its sheer size and the large amounts of capital inflows that are entering the country not just from the developed nations but also from regional economies such as Taiwan and Singapore.

The weightless economy can be defined to comprise four components (Quah 2000):

1. Information and communications technology, thus including the Internet and telecommunications;

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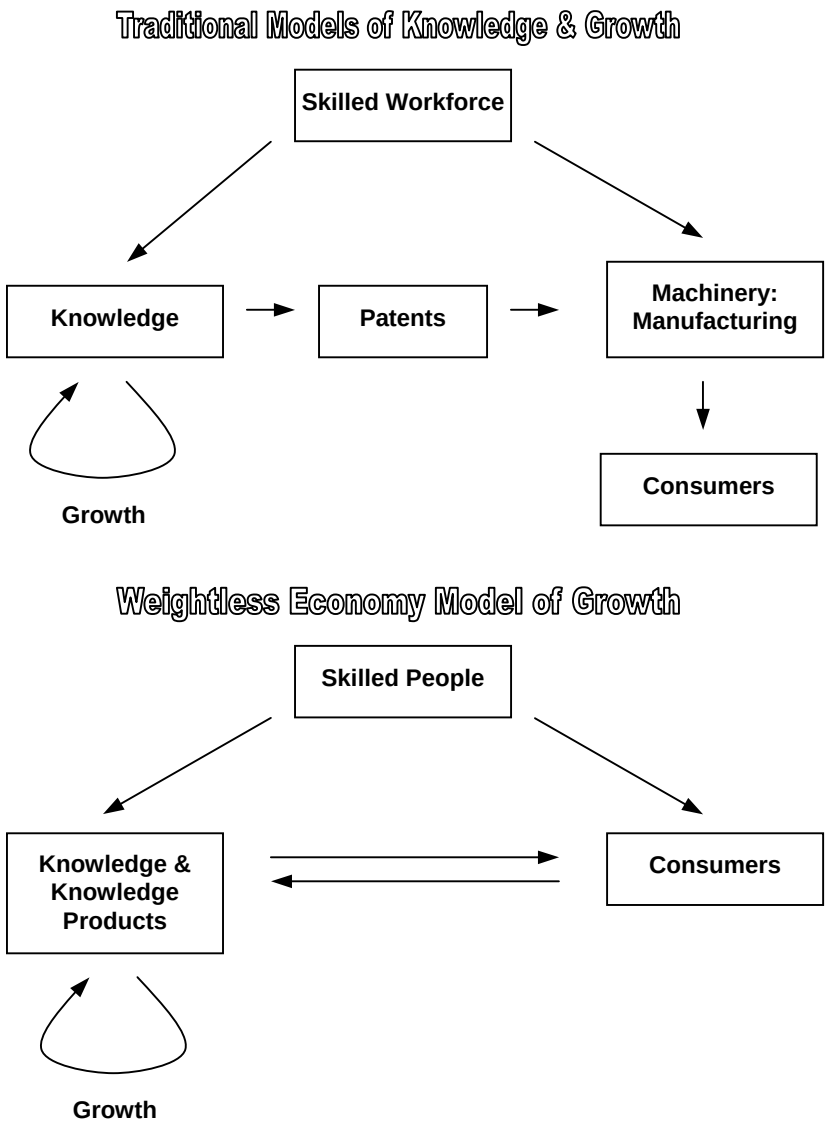
[28] Examples of each in the East Asian context are SESAMi (an B2B portal specialising in a range of industries), Amazon.co.jp (the Japanese arm of the B2C bookseller) and InterAuct! (a C2C auction site based in Singapore).

[29] See, for example, Lucking-Reiley & Spulber (2001).

[30] This has also meant that ICT has expedited and advanced cross-border trade and investment flows. For more on trade and investment in East Asia, see the paper by Okamoto & Nakagawa, elsewhere in this volume.

2. Intellectual assets broadly construed – not just patents, but also copyrights, trademarks, music, video entertainment, advertising, images, industrial trade secrets, financial consulting services, health and medical consulting, education, and so on;
3. Electronic libraries and databases;
4. Biotechnology: Carbon-based libraries and databases.



Source: Quah (1999)

Figure 1: Models of Knowledge in Growth

These components of the knowledge economy are characterised several economic aspects. First, due to the negligible marginal costs of production and distribution, there is an infinite potential for expansibility, and *ex post* economic efficiency would imply its free dissemination. However, acting in tension to this is the absence of any *ex ante* incentive to

produce knowledge should its compensation be nil. Second, in contrast to the standard model for knowledge and growth (Figure 1a), the weightless economy reduces the effective distance between consumers and knowledge producers, fostering positive consumer feedback effects that drive the growth process (Figure 1b). Third, sources of growth led by knowledge include innovation through the use of human capital (Grossman & Helpman 1991; Levinson 2000), a proper institutional framework that supports R&D (Porter 1990), and even the rate of population growth[31] (Beaudry & Green 2001).

These factors pose as challenges to East Asian nations. In order to develop human capital, manpower policy in Asia Pacific nations has to rapidly evolve. Levinson (2000) has argued that education, together with technology – in particular, technological training and exposure to ICT – are the necessary ingredients that equip human capital for the ICT revolution, and is possibly the single most valuable development intervention. With the exception of Japan and the NIEs, East Asia has to upgrade its levels of both math and science education, coupled with higher utilisation levels of computers.[32] Here, ICT provides the very solution to the problem – computer assisted and Internet-based learning would open the doors of opportunity to a wider segment of the populace than ever before.

In transition economies and, to a lesser extent, emerging Asian countries, rigidities that impede inflows of skilled manpower remain in the labour markets, and should be removed. In particular, policies that promote foreign talent recruitment and local talent retention should be pursued. These policies, together with productivity gains from ICT, should lead to improvements in employment performance. However, this should be an outcome of

[31] This may seem somewhat counter-intuitive. Beaudry & Green (2001) argue that differences between industrialised nations can be accounted for by population growth differences; specifically, that technological adoption is positively correlated to the population growth rate (due to the possibility of leapfrogging that arises through taking advantage of the abundance of human versus physical capital). Hence, for countries with higher population growth rates, such as Malaysia or Thailand, the possibility of leapfrogging not just exists, but can be exploited.

[32] The coupling is important. Vietnam, which ranks high in the quality of its education system, is ranked poorly in terms of overall competitiveness by the Global Competitiveness Report (Porter, Sachs, Warner & Schwab 2000) precisely due to its low levels of computer use.

microeconomic reform, not macroeconomic interference with monetary policy, which is likely to tempt an erosion of the central bank's credibility.[33]

Institutional reform in East Asia is somewhat of an enigma, not least because the so-called unholy trinity of corruption, cronyism and nepotism permeates many levels of society, both public and private.[34] Still, the resounding lesson from the Asian financial crisis is the importance of good corporate governance and a sound institutional environment, and this is not negated by ICT. With proper institutions in place, the dissemination of public policy is eased, and distortions that arise from market failure are less likely to occur. With regard to R&D, these would include a national innovation system that co-ordinates science and technology policy, oversees R&D bodies and pools national technological resources, a sound legal and regulatory framework, adequate ICT infrastructure, and developed financial bodies that provide venture capital financing.

For physical infrastructure, the approach would depend on the stage of development of the country. Obviously, there is a logical progression in the task: there is little use of discussing digital broadband networks when telephone penetration rates are dismal. The transitions economies, especially Cambodia, Laos, and Myanmar, will certainly need to upgrade their respective ICT infrastructures. Similarly, in the absence of reliable electricity provision, the fastest computers add little to productivity. Here, technologically backward countries possess a distinct edge, as the absence of legacy systems there affords the opportunity to leapfrog. Non-physical infrastructure will benefit from deregulation in the ICT sectors, drafting of laws that explicitly recognise electronic transactions and protect intellectual property, and a caution policy stance in engaging in the taxation of e-commerce and ICT.

Although a focus on the supply side of the ICT equation is clearly an important driver of ICT development, Quah (2001) has convincingly argued that the source of growth in the future would not be supply, but rather demand-driven. In this respect, therefore, the Asia Pacific clearly has the greatest potential for growth and leadership, as evidenced by the brazen pervasiveness of high-technology products in most major Asian cities. Indeed, Japan could be

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[33] This opens up an entire Pandora's box of arguments for and against interventionism, and the existence of a trade-off between inflation and unemployment. Suffice to say that mainstream economic thinking subscribes to minimal interference in monetary policy to counter unemployment. See Fischer (1990) for a broad survey.

[34] With possibly the exception of Singapore. See the various reports produced by the Political and Economic Risk Consultancy (PERC), especially, PERC (2001).

the catalyst for East Asia, as it already has led in establishing a global presence in the adoption of wireless communication technology and advanced consumer electronics.

Disenfranchisement of Small States? Global Governance and Security Concerns[35]

The globalisation process poses external challenges to sovereign states, especially small states, including those of the Asia Pacific. These are best summarised as challenges to governance and security. The varying – even haphazard – degrees of global governance efforts has led to different degrees of social and economic exclusion among different people groups. This occasions the need for the East Asian governments to negotiate with the international institutions[36] that establish regulation and standards in the globalised network economy in order to avoid being marginalized or excluded from the global network economy. It is important that their voices are heard, as these organisations can powerfully influence ICT investment flows, protect individual privacy, and ensure information security, and there have been allegations of late concerning systematic unfairness in ICANN's Universal Domain Name Dispute Resolution Policy (UDRP) (Geist 2001).

A possible way forward would be to get the regional house in order. Through ASEAN+3 agreements, a common regional standard for e-commerce and intellectual property initiatives can be meted out. This cannot be overemphasised as the departure of East Asian standards from international norms have been soundly criticised by Western governments. This applies even within regional fora, especially for the transition economies that have already experienced some form of international isolation. In addition, there could also be a role for the Oceania countries to aid in the establishment and continued development of these standards, especially given their position as more mature democracies with a stronger tradition of respect for intellectual property and rule of law.

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[35] This section confines itself to a discussion of the international relations aspects of ICT in the Asia Pacific. An extended discussion of the relationship between the region and international institutions is presented in the paper by Tangsupvattana, elsewhere in this volume (especially in the final section).

[36] These include, but are not limited to, the International Telecommunications Union (ITU) and the International Consortium for Assigned Names and Numbers (ICANN).

Digital Gaps Within and Among Asian Countries – Locating ICT within a Country Framework

ICT is embraced by many developing countries in Asia as the solution to economic development and to strengthen state governance.[37] In this regard, ICT is seen as both a technology and a discourse for national development. Informed by Thomas Kuhn's *The Structure of Scientific Revolutions* (1962),[38] writers such as Andrew Webster stressed the strong linkages between technology and society. Science and technology affect and are affected by the economic, cultural and political aspects of society. Hence, the production of technology is a common good that must be integrated with social development and equity values (Sapp 2001).

Digital divides exist both between countries, as well as within countries, and take several permutations.[39] Inter-country gaps may be wide, but tend to be harder to address. In this respect, the divide is mitigated in part by production networks,[40] the free flow of trade in ICT goods and services,[41] and the e-ASEAN agreement.[42] Future efforts might wish to explore the possibility of a sustainable regional innovation system.[43]

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[37] See for an example of a National ICT plan, see Malaysia's Vision 2020 at http://www.nitc.org.my.

[38] According to Kuhn, paradigms of scientific discourse go through the pre-paradigmatic stage leading to the emergence of normal science. However, anomaly and crisis may emerge which will lead to the birth and assimilation of a new paradigm. The actors in this process, namely the scientific community, play a significant role in determining the course of the paradigm development and acceptance. Hence, a scientific discourse is sociologically defined by education, professional interaction and communication, similar interests and acceptance of a particular range of possible solutions (Zynda 2001).

[39] Although there are some factors more commonly used to measure the digital divide. These include fixed tele-density, mobile tele-density, personal computer (PC) density, Internet host density, secure server density, and e-commerce usage density (Fazio, Simone, Gregori & Riccardini 2000).

[40] Empirical studies suggest that such production networks are extensive across East Asia, especially in the context of ICT goods (Borrus, Ernst & Haggard 2000).

[41] There has been remarkable achievement in promoting unfettered trade in ICT goods, and more recent initiatives toward region-wide economic cooperation have posited, *inter alia*, unrestricted trade in ICT goods, services and investment, and possibly even labour.

[42] The e-ASEAN framework set the precedent for regional co-operation in ICT through free trade in ICT goods and services, the establishment of an ASEAN Information Infrastructure (AII), the enactment of e-commerce guidelines, capacity building in ICT, and e-society and e-government initiatives (ASEAN Secretariat 2000a). In

The framework for analysing the impact of ICT and digital divide is more productive if taken at the country level. Often, intra-country divides mirror existing income, rural-urban, racial, gender, educational, and generational gaps (World Bank 2000). Different disadvantaged groups in a country suffer from a combination of exclusions, making it even harder for them to access and benefit from social and economic resources such as ICT. As observed by Touré (2001), the disparity is more in countries with large rural areas such as Malaysia. Its rural population makes up 43 per cent of total population but Internet penetration is 35 times higher in Kuala Lumpur than in the state of Kelantan. Around 25 per cent of households in eastern Malaysia have no electricity, as compared to 100 per cent coverage in peninsular Malaysia. In China, Net users are the elites in the cities. This minority tends to be young, educated, wealthy, single and male (Hachigian 2001a). However, a significant segment of China's population is in the rural. The rural population stood at 34 million in 1999 (UNDP 2001). In Nepal, 11 percent of the wealthiest households have access to a phone. In comparison, only 0.5 percent of households in the previous quintile have access to a phone. In addition, the ratio of private phone access in urban and rural regions is 1 to 100 (World Bank 2000).[44]

Wong (2001a) cautioned that the natural market forces in the Asian ICT market is fragmenting Asia into many small markets divided by language, culture, technical standards, lack of legal institutions and other barriers. He suggested that nations must simultaneously develop their national policy towards promoting regional cooperation and cross-border transactions while focusing on country level development. This is due to the interconnected nature of ICT diffusion across countries and the increasing gap between developing and developed countries[45] in an increasingly globalised economic system.

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the November 2000 Summit Meeting of the ASEAN+3 nations, agreement was made to extend the initiative to include China, Japan and Korea (ASEAN Secretariat 2000b). See the task force website: http://www.e-aseantf.org.

[43] This proposal is one worthy of consideration. Beyond e-ASEAN, there is a need for homegrown centres for science and technology where research can be conducted in any of the centres of excellence in the region. For example, one can envision agricultural research into rice biotechnology that begins with funding from capital markets in Hong Kong, genetic sequencing in Singapore using bioinformatics technology from Japan and Korea, testing in the Philippines and Thailand, and actual production in Vietnam or Cambodia.

[44] The development of mega-cities is also a more general demographic challenge facing the Asia Pacific. See Yu, elsewhere in this volume.

[45] Wong analysed that the six less developed Asian countries have an average level of ICT adoption about one tenth of levels achieved by the five advanced Asian countries in 1998. However, the ratios for Internet hosts and secure commerce hosts are much worst, at 3 percent and 2 percent respectively (Wong 2001a). One fifth of adults

It is therefore an absolute necessity for the Asia Pacific to address this growing disparity in tandem with social welfare measures adopted by countries for their citizens. Embedded in ICT is the potential for it to be a social leveller, as it affords small and medium enterprises greater access to markets and gives individuals access to information once the preserve of the wealthy upper-class. Policymakers should therefore consider policies aimed at both the public as well as private sector. For example, enhancing learning and educational opportunities through electronic delivery methods could be implemented through accrediting private providers that use ICT and the Internet as an instructional tool (as has been experimented with in Singapore), as well as funding the use of ICT in public universities (most common among the NIEs, although increasingly common in all of the Asia Pacific save for the transition economies). Other policies should target improving access to ICT.[46]

It should be noted, however, that there are dissenting voices as to how the information highway should be paved. In particular, Baker (2001, pp. 1-2) argues that

> "A disservice is done in reducing the apparent inequities in the diffusion of the technologies to a simple socio-economic concern. Rather than a one-dimensional 'digital divide', more accurately there is a policy problem related to the use and deployments [*sic*] of ICTs with multiple geographic, social, economic and organisational components…. Further, ICTs present policymakers with an array of complex issues that extend beyond purely technological concerns…. Rather than answering the question of how should public sector functions respond to the changes made possible by diffusion of ICTs, a more critical step seems to be to accurately gauge the nature of the issue rather than jump in and lay 'digital pavement'."

These country profiles highlight the complexity of ICT development in countries in the Asia Pacific. The specific political-social-economic contexts of the countries are fundamental considerations in understanding the impact of ICT on the countries and the region. Simultaneously, it is important to understand the process and factors affecting ICT development.

Processes and Factors Affecting ICT Diffusion in the Asia Pacific

Within the discourse of ICT as technology, ICT is seen as an innovation. It is an idea, a practice or object that is perceived as new. Generally, in any population, there are five profiles

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in developed Asian economies compared to less than one percent of those in the developing countries are Net users. The number of Net users in Singapore is the same as that of the whole of Indonesia, although Indonesia has 50 times its population (Touré 2001).

[46] A proposal for doing so is through the use of tele-centres, discussed later in the paper.

of innovation adopters with specific characteristics, as shown in Figure 2 and Table 1 (Rogers 1995).

Source: Rogers (1995)

Figure 2: Diffusion of Innovations on the Web

Categories	**Characteristics**
Innovators (2.5%)	Venturesome, cosmopolite, networked with other innovators, financial resources, understand complex technical knowledge, cope with uncertainty
Early Adopters (13.5%)	Respectable, more local than innovators, strong opinion leadership
Early Majority (34%)	Interact frequently with peers, seldom hold positions of opinion Leadership, interconnectedness to the system's interpersonal networks, long period of deliberation before making an adoption decision
Late Majority (34%)	Adoption might result from economic/social necessity due to the diffusion effect, sceptical and cautious, relatively scarce resources
Laggards (16%)	Most localised, point of reference is the past, suspicious of change agents and innovations few resources

Source: Rogers (1995)

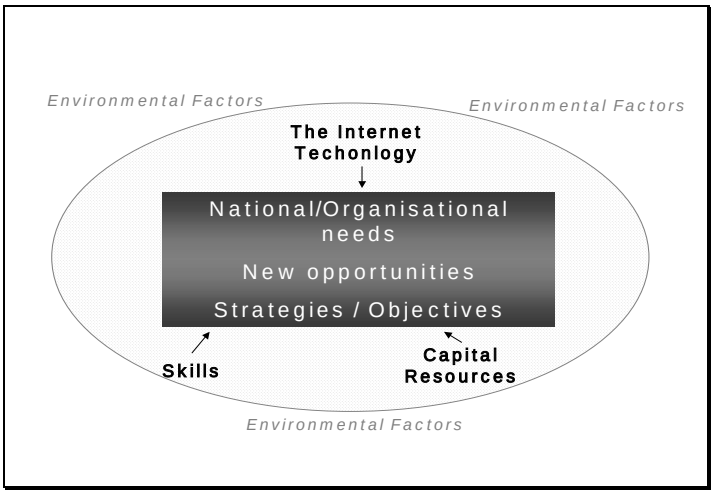
Table 1: Innovativeness and Adopter Categories

For each of these groups, the rate of adoption of ICT is based on several factors. Two significant ones are: compatibility of the idea of ICT with existing values, past experiences and needs of potential adopters; and observability of the results of the innovation to others (Rogers 1995). For both factors, the roles of opinion leaders and the mass media are vital in creating a widespread culture of acceptance and information transmission.

Two groups are of concern to promoters of ICT as economic and social development. They are the 'Late Majority' and the 'Laggards', which make up half of a population. The characteristics of the 'Late Majority' allow for intervention via the route of work skills training or linking ICT development to economic gains. However, it will be a challenging task to reach out to the 'Laggards'. Yet in the face of globalisation and a mobile workforce, this group is preciously the one that tends to be excluded. Hence, more attention and resources must be channelled to this group.

Having established how different segments of society make sense of and accept innovation, we need to examine how the infra-structural processes factors can support their adoption of ICT.

In their study on ICT rollout in 30 developing countries, Bazaar and Boalch (1997) identified five components that are necessary for the rollout and use of Internet. They are national/organizational needs and/or new opportunities; technology; people/skills; capital resources; and management of technology adoption and diffusion process. The management of adoption and diffusion process in Figure 3 lays out how these components are connected.



Source: Bazaar and Boalch (1997)

Figure 3: Management of Adoption and Diffusion Process

Bazaar and Boalch identified the most important component impacting ICT rollout as the underlying telecommunications infrastructure. Other factors affecting the diffusion process are:

1. *Infrastructure* within the country as well as capacity of international links
2. *Policies and regulations* towards telecommunications and internet services

3. Level of *economic development* of a country
4. *Cultural factors* play a significant role in adoption and integration of the community with the global community. These factors include individual beliefs, value systems, attitudes to information sharing
5. *Language barrier*

The above studies explain why ICT diffusion within a country and across the region is full of diversity and differentiation resulting in an increasing gap between countries and within parts of countries.[47] For the Asia Pacific, in particular, there is a danger that its global leadership in ICT production is not being translated to deep diffusion within the society and economy in its use, except perhaps in the NIEs. The traditional emphasis on production therefore needs to shift towards adoption and utilisation of technology as a medium for economic growth and development. Although this has been more evident in major cities, there is a need to break down the rural-urban divide – a need that could best be addressed by governmental policy.

Social Development and ICT Diffusion – A Central Role for the State?

An evident implication from the above studies is the need for strong leadership and concerted efforts at the national level to promote the development and acceptance of ICT in economic and social development. If not taken up, a worst-case scenario could be that of a 'Fourth World' as suggested by Castells (1998). There is a systemic relationship with the growth of social exclusion and the 'Fourth World.' The 'Fourth World' is made up of people and regions that are of no use to the dominant interests in 'informational capitalism'. They offer little or no contribution as either producers or consumers. They are the uneducated, functionally illiterate, sick or mentally unfit and chronic poor. For example, in the Philippines, it is unclear as to the extent in which the 2000 'People Power II' revolution benefited the masses. With only 2 per cent of the population having access to Internet, its civil society is conscious that IT should impact on the "touchstone issues on which moral victories are translated", such as agrarian and electoral reforms (Sicam 2001).

In order to understand the impact of ICT on the entire range of population, a suitable framework of social development must be selected. James Midgley, a key proponent of the

[47] The studies by Wong (2001a), Bazaar and Boalch (1997), Touré (2001), and Rodríguez & Wilson (2000) all share similar conclusions.

Social Development approach,[48] exemplified the optimism among developmental workers in seeing the globalised economy as providing opportunities for developing countries to further integrate their social development with economic development (Midgley 2001). However, as cautioned by Castells, it requires political will, international cooperation and investment from the business sector to reduce marginalisation of countries or parts of the countries in ICT development (Castells 1998).[49]

Castell's (1998, p. 2) definition of 'Social Development' best summed up the values and approaches needed:

> "Social Development today is determined by the ability to establish a synergistic interaction between technological innovation and human values, leading to a new set of organizations and institutions that create positive feedback loops between productivity, flexibility, solidarity, safety, participation and accountability, in a new model of development that could be socially and environmentally sustainable."

China's recent $2.5 million pilot ICT project with UNDP to reduce poverty in rural areas is an apt example. The ICT centres will provide information on current market prices, new agricultural technologies and methods of sustainable farming to help improve families' livelihoods and develop longer-term ICT-related businesses in the rural areas. The initiative will also facilitate two-way communication between communities and administrative units on public services, regulations and policies, promoting transparency and participation (UNDP 2001).

In order to reach equitable social and economic goals, it would seem that a centralized ICT diffusion system with the state taking the lead is needed. Touré (2001) spelt out three basic areas for the government to develop ICT. The government must be a user of ICT in its administration and planning. The benefits of computerization and a computer literate civil service is greater efficiency, transparency and cost saving. As a developer of content to stimulate ICT use, the government can lead the development of locally relevant content and applications. Finally, as a promoter of ICT, the government should create enabling legislation, infrastructure building and liberalization of markets.

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[48] The *Social Development* approach in improving the quality of life of people is through the integration of social welfare and economic development (Midgley 1995).

[49] For example, Rodríguez and Wilson (2000) found out that most developing countries are not associating economic growth and use of ICTs.

Singapore is a good example.[50] The primary advantage of a centralized diffusion system is that the state finances and coordinates R&D and communications infrastructure building. On the other hand, the state also carries out centralized decision making leaving the people as passive adopters (Rogers 1995). Hence, Baker (2001) advocates for a decentralized, bottom-up approach in developing public sector ICTs so that the focus can be localized and the technological skills can be leveraged to address community issues. However, the disadvantage of this approach is that the local communities may lack technical expertise to diffuse effectively and that unpopular innovations are not diffused.

The ideal diffusion system may be for the state to adopt both the centralized and decentralized diffusion systems for different population profiles. The development of rural ICT diffusion is best centralized while a decentralized system of development will suit an urban population, especially those that are already Net-savvy. The danger, of course, of increased political participation in the diffusion of ICT is that political economy issues come in to play. Well-connected political elites as well as special interest groups, especially the ICT business lobby that can be sizeable in some Asia Pacific nations, might exert a disproportionate amount of influence on government policy, especially in countries where the political players adopt a more myopic stance in policymaking. Moreover, when the issue of political liberalization is added to the goals of social development, the situation becomes more complex.

Changing Government-People Dynamics

ICT is seen as a political liberaliser by some writers such as Rodriguez and Wilson (2000) and Tiihonen (2001). They argue for low levels of government distortions and greater space for democratic rights and civil liberties. While this is the general discourse adopted by

[50] The multi-media 'e-citizen' website is planned as a one-stop portal for citizens to access public services, information and governmental ministries. It is designed according to the life journey of a citizen, from birth to demise (http://www.ecitizen.gov.sg). Nationwide efforts were carried out to wire up households, provide affordable PCs to encourage Singaporeans to use the Net (Rodan 1998). Concurrently, the government encouraged citizens to adopt an attitude of life-long learning so as to prepare the workforce for the new economy. The most recent effort is a National IT Literacy Programme (http://www.nitlp.com.sg). It is aimed at equipping all Singaporeans, especially senior citizens and homemakers with basic IT literacy skills such as Internet surfing, e-transactions and IRC. Courses are affordable and the programme is taught in four languages – English, Chinese, Tamil, and Malay.

Development workers, some strong states in Asia, such as Singapore (Rodan 1998)[51] and China (Kalathi & Boas 2001)[52] are using ICT to continue its political stronghold.

Having established that, it is important to note that in some ways, ICT revolutionalise government-people dynamics. Essentially, ICT facilitated empowerment by providing tools for civil society groups to communicate and organize among themselves and with other groups. This takes place locally, nationally and globally. The interconnectivity and real-time organization is a powerful force. Another significant dynamic is the increasing gathering and exchange of information globally, with planning done locally to tailor-suit specific country contexts. These developments create some new rules of engagement between the government and people at both the national and global levels.

Globally, the Internet and mobile phones are used to stage protests in events such as WTO meetings (Canadian Security Intelligence Services 2000). There are national examples such as the ouster of Estrada (Sicam 2001) and the Falun Gong's April 1999 protest (Kalathil & Boas 2001).

Increasingly, the people are using the Internet as a political tool. A study by the Chinese Academy of Social Sciences suggested that the Chinese Net users regard the Internet as a political instrument and rely on the Net as a primary source of information. More than 70 per cent of those interviewed saw the Internet allowing people to express their political views. Indeed, there is evidence of political empowerment in China's civil society development. The few advocacy groups are increasingly plugging into the network of activists thriving on the web. In addition, those with niche or discouraged interests, such as the gay community, band together with specialized web pages and discussion groups (Hachigian 2001c).

The range of government-people engagement is varied. Internet terrorism, such as the hacking of commercial companies during the 1999 'J18' demonstration in London (Canadian

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[51] Singapore's recent amendment to the Parliamentary Elections Act (Ng, 2001) is seen by some observers as the tightening of online political space Political parties can campaign in cyberspace within certain rules. It is seen as a response by the State to the evolving political culture of Singaporeans utilizing the cyberspace for activism. This activity is growing rapidly given the fact that Singapore has the highest ICT penetration rate in Asia (48 percent). An example of political activism on the Net is the NGO, The Think Centre (http://www.thinkcentre.org).

[52] While China encourages the country to be wired up and exercises tight political control over the urban Internet users, it allows for pockets of relatively free space. The police rarely shut down chat rooms of online university bulletin boards, which carry politically charged criticism against the state. It recognizes the need to give elites a sanctioned place for fairly free speech (Hachigian 2001).

Security Intelligence Services 2000) may represent one extreme aspect of civil society in ICT age. However, there are other exciting and constructive movements. Communities of like-minded people are also linked up on the Net. These communities range from 'a Civilization of the Mind in Cyberspace', as outlined in 'A Declaration of the Independence of Cyberspace' (Barlow 1996), to Singapore's gay community finding more security and space on the Net (Ng 1999). On the development front, aid agencies are integrating technology with local culture in popular entertainment projects such as Meena,[53] where the rural population in South Asian countries are educated in gender and child rights. In the Asia Pacific, the Western Australian state government has introduced a portal site for increased feedback from the populace regarding state-related issues.

A wider concern could be privacy issues raised by government monitoring using technology, especially in the light of the terrorist attacks of September 11th. Face-recognition technology, realised by advances in ICT, has already been used in London's Heathrow airport to help identify potential terrorists. The extension of this to other criminals, and then on to private individuals, is a fine line that raises the spectre of Big Brother and Orwellian fears of 1984. At the same time, however, political control continues to erode as technology holds the key to sidestepping such government-imposed barriers. Already, the Internet firewalls enacted by China and Singapore are increasingly riddled with loopholes,[54] and it would seem only a matter of time before these are either explicitly or implicitly dropped due to their ineffectiveness.

Underlying these advances is a consistent process of mindset changes and cultural transformation facilitated by the ICT technology. Perhaps this is the most significant impact of ICT on government-people dynamics. ICT opens up resources such as communication channels for risk-takers and innovators to evolve ways of doing civil society and advocacy.

Erosion of National Cultures and Values and the Evolution of a Globalised Culture

ICT as technology can be seen as a cultural tool for both expressed and experienced culture that does not exist in isolation from the social system (Carolan 2001). Citing Turner, Carolan explained that we are now at a "liminal moment" of history in terms of technology and ICT, where we are betwixt and between the positions assigned and arrayed by law, custom,

[53] http://www.unicef.org/meena.

[54] For example, various anonymiser software and websites offer encryption of electronic trails, allowing one to evade a firewall to a blacklisted site.

convention and ceremony. Hence, ICT as a communication tool provides channels for different groups of people, whom previously would not interact, to connect with each other. Gans (1999) identified five taste publics in a population. Taste publics are networks of individuals that exchange products and interact with surrounding structures. The five taste publics are high culture, upper-middle culture, lower-middle culture, low-culture, and quasi-folk culture. Technology as a communication tool is a powerful mediating force that provides the flexibility to permit individuals to break routine and rapidly exchange knowledge. This results in empowered individuals forging new social ties in and among taste publics.

As observed by Shamsul (2000), the formation of the ICT culture is one of 'fragmengration'.[55] The culture thrives on fragmentation, cross-cultural permutation and integration and rationalization of various resources. In face of these culture-formation processes and dynamics, the cultural contestation between national and global culture becomes a great concern to national governments (Shamsul 2000).

Beyond urban lifestyle fads fuelled by MTV, certain post-modern cultural traits such as open-mindedness, ability to accept and relate to multiple truths and realities, are associated with Net users. Indeed, the educated and wealthy Chinese Net users are found to be more open-minded (Hachigian 2001b). The twenty-something young Philippinos taking part in the People Power II Revolution are termed 'generation text'. One of them described their values as "free, fun-loving and restless". However, they are also serious and committed articulating values such as "insistent, hardworking, strong and patriotic" (Eder 2001).[56]

The cultural impact of ICT can be empowering and liberalising. The evolution of anti-globalisation demonstrations and people's political up-rising may see a convincing contest to the hegemonic hold of political and cultural power by the state and other institutional powers that be. In other words, the contest is cultural production and the prize is ownership of a reality meaningful and beneficial to the powers that be. As observed by Shamsul (2000), the tension in this clash of culture-formation is partly due to the state's fear of losing power and control over the majority in the society and the possible dramatic fast-paced social changes. For example, the Burmese government launched its first week-long email campaign targeting

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[55] According to Shamsul (2000, p. 72), "fragmengration = fragmentation + migration + integration".

[56] It should however be noted that this belief in an eventual confluence of culture is not held by all academics. This disagreement is perhaps best understood in terms of the Fukuyama-Huntington debate, the former who believes in the universality of certain cultural values, such as democracy, and the latter who instead asserts that modernisation leads to a resurgence in the strength of several civilisational blocs. See Fukuyama (1992) and Huntington (1996).

journalists in 2000, against Aung San Suu Kyi's National League for Democracy (NLD). The emails came with digital images attachment of semi-nude NLD leaders (Krebs 2001). The Muslim authorities in Singapore recently rejected divorce via a short message service (SMS) on the mobile phone (Straits Times 2001). In Thailand, while the Net spurred the growth of the pornographic and prostitution industry, it also provided for Thai women to log on frequently to the internet chat rooms to find out more about the activities of their unfaithful husbands and to pick up sex tips (Tang 2001).

The pace of cultural production and the variety of ways it combines with economics goal is accelerating. For example, Bhutan was connected to the Internet by the UNDP's 1997 Asia-Pacific Development Information Programme (Wong 2001b). Four years later, it announced the launch of its first daily newspaper on the Net (KnowNet Initiative 2001). Digital advertising would fund the newspaper. With this move, the objective of the UNDP for Bhutan is to raise their national income with Internet-based activities is beginning to see results. This could be a possible model for the transition economies of East Asia to follow.

There is therefore an urgent need for decision-makers to understand the dynamics and interplay between culture making, economic development and social goals in the adoption of ICT in national development.

The Way Forward – Evolving a Mindset Change and Regional Cooperation

From the discussion on how ICT impacts upon and is impacted by the social and economic factors in national development, driving factors as well as possible dangers are identified. It becomes evident that there are several emerging directions and actions for its effective development. Given the increasing digital gap within and between countries in Asia and the Pacific, the framework for these actions must be simultaneously taken at the local, national and regional levels to prevent a scenario of outright 'winners' and 'losers' in the globalised knowledge-based economy.

Governments seem to be the most prominent and leading actor in developing and using ICT. Even if it cannot finance the building of a broad base info-communication infrastructure, it should coordinate its long-term development so as to reduce excluding different sectors of the population, such as the rural areas and the urban poor. However, political will and an efficient government are crucial for the government to take the lead role in ICT development.

In the area of social development, ICT diffusion and adoption is most effective if tied up with economic goals and is sensitised to the local contexts. The development of human capital, via

education is crucial so that the younger generation can 'leapfrog' their utilization of ICT from the older generation.

Fuelled by the ICT technology, the emergence of a global civil society with local sensitivity will continue to grow and strengthen. Governments will find it increasingly complex to engage the people sector and the local civil society will increase its sophistication in its advocacy.

The above developments necessitate countries in Asia and the Pacific region to share information with each other and to cooperate more. This need for regional cooperation is crucial in the face of fast and new changes as a globalised ICT culture and economy evolves. The Okinawa promise by Japan to provide US$15 billion (over 5 years) in funding for the narrowing of the digital gap, mainly in Asia Pacific countries, is an example of a region-wide effort to address the problems and opportunities presented by the ICT revolution.[57] Similarly, the e-ASEAN framework, once it has been established, could easily be extended to the north Asian and Oceania countries, providing an Asia-Pacific-wide ICT infrastructure.

A concept that seems to be reaping some encouraging impact is that of tele-centres, either stationary or mobile. The aim is to develop human capital, promote local community empowerment and generate economic revenue. Tele-centres are strategically located facilities that provide ICT access to the pubic. The range of services and applications include telephony, fax, email, Internet, multi-media hardware and software. These tele-centres also act as community information centres (Oestmann 2001).[58] Children are taught how to use the computer and Internet. Farmers are able to access the latest prices for commodities, which cuts out the middleman, enabling farmers to get the best prices (Wong 2001b). International development agencies such as the UNDP are funding the erection of such centres in both rural and urban areas in developing countries. In India, there are already 10,200 such centres in

[57] For more on the efforts by the G8 in bridging the digital divide, see the Okinawa Charter on Global Information Society (G7-G8 Secretariat 2000).

[58] Oestmann (2001) identified three factors why tele-centres may enjoy some financial advantages over developed countries. In areas where the tele-centre is the only basic telecommunications provider, a larger income can be gained. The income can be invested in comparatively cheaper technology such as wireless or satellite to build new tele-centres and an infrastructure in yet to-be-reached areas. Private developers may benefit from state funding to build tele-centres. The low PC penetration of small businesses and households ensure a much needed and increasing demand for tele-centres. So far, tele-centres in developed countries seem to be able to either break even or generate income. Development agencies are encouraging private developers to make these tele-centres profit generating in Asia's developing countries.

1996. The project is currently being initiated in Vietnam and the Philippines, and these could be a case study for the Asia Pacific.

Central to all the emerging directions and encouraging initiatives in promoting ICT development, state and people-sector decision-makers must adjust their mindsets to incorporate the impact of ICT as a potential liberalizing and empowering tool for the marginalized. Some crucial attitudes needed include open-mindedness, be willing to live with higher risks and uncertainty and to share resources and control with a larger pool of stakeholders.

Although the importance of engaging in ICT should not be overplayed, given other development priorities, if a policy of active engagement in ICT is adopted by the Asia Pacific, the countries of the region, and even the region as a whole, will be greater prepared to handle developmental issues and challenges that will arise, be it from the ICT or biotechnology or another scientific revolution. This stems from the fact that ICT, in its essence, is a facilitator and a tool, and such tools, when harnessed properly, can allow an acceleration of the other development and economic goals. Although it is possible that countries that do not engage ICT may continue to find niches in the global economic framework, a complete neglect of ICT policy will only make the inevitable future attempts to introduce it into the economy more difficult and dislocative.

IV. Conclusion

In the final analysis, attempting to isolate and fully determine the manifold impacts of ICT is close to an impossible task. Like the mythical hydra, where for every head severed, another two would grow in its place, trying to break down the many different areas will only lead to more ancillary influences and cross linkages, *ad infinitum*. Hence, the best way forward is to look broadly at the broad impacts associated with ICT and the causes of these impacts, as shown in Figure 4 below.

For any individual impact, it can be viewed in an optimistic, neutral, or pessimistic stance. Similarly, one may adopt several worldviews in interpreting these impacts: technological determinism, contingency, or social determinism. The schematic diagram provides a parsimonious framework for studying any impact of ICT, not only those that have been specifically addressed in this paper.

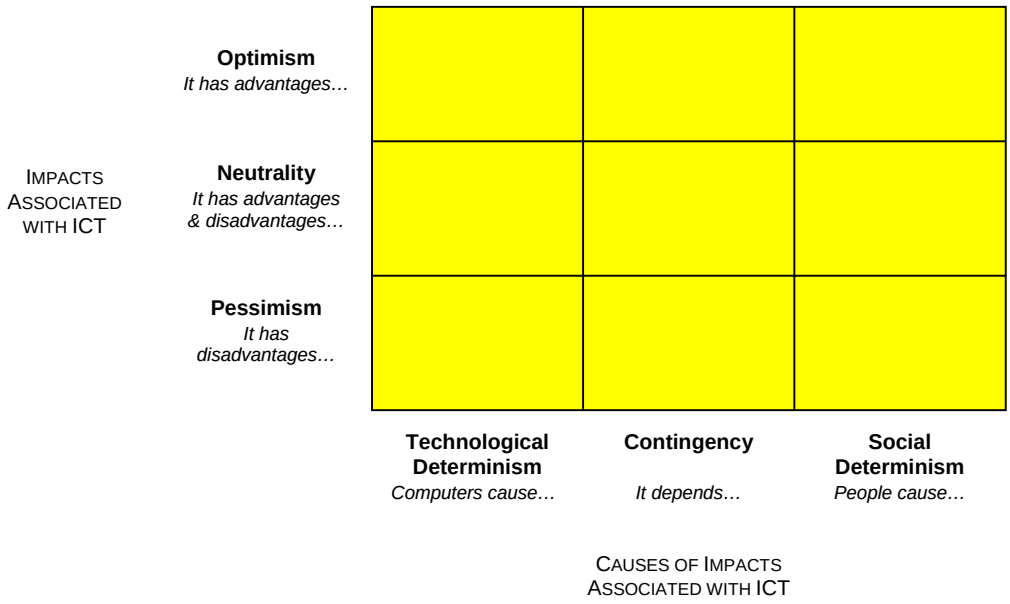

Figure 4: Schematic Diagram for Analysing the Impacts of ICT

Yet, the overall trend from this study, as eluded to throughout the paper, is the clear diverging pattern of development in terms of ICT between nations; on the one hand, the NIEs of Hong Kong, Korea, Singapore and Taiwan, together with Japan and most possibly China appear to have better grasped the essence of the information revolution, and have taken appropriate steps to push their economies and societies towards an advanced, highly-informatised one. The other nations will need to actively engage in ICT developmental strategies if they wish to keep abreast in the ICT revolution. More likely than not, however, due to the multiple priorities that their economies face, ICT will tend to be a lesser objective. This will prevent much of developing Asia and the transition economies from reaping the full benefits of the information economy.

The limitations of the paper stem from the general intractability of the subject matter. It is, by its own admission, incomplete, although as many key impacts as possible have been dealt with, and especially those that have a significant effect on the Asia Pacific economies. This naturally opens the avenue for future research into narrower areas than those that were discussed. In particular, three fronts for future exploration stand out: the proposal for an ASEAN+3 supranational innovation system, a detailed analysis of the international relations aspects of ICT, and studies on local solutions to absorb and address the negative social impacts of ICT. Also, urgent research is needed in examining how fringe economies such as those of Malaysia and Thailand can propel themselves forward in ICT development, and how technologically recessed economies, especially the transition economies of Cambodia,

Myanmar, and Laos, can leapfrog the ICT development process – perhaps using Vietnam as an early model.

It is perhaps useful to terminate with a caveat and a warning: ICT is, and remains, a small force in the greater scheme of development goals and objectives. Only 1 per cent of the world's population owns a computer, and any ICT initiative or policy should keep such a statistic foremost in mind. To concentrate exclusively or excessively on ICT development would not only be myopic, but even counterproductive. In the light of alternative economic priorities and social agendas, this is a distraction Asia Pacific countries can ill afford.

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