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Non-linear and Dysfunctional Development Path of Information and Communication Technology: Cultural Conflicts

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Suggests that a non linear path may exist for the development of ICT reflecting late entrants having access directly to the later stages achieved in the mature entrants. This access allows late entrants to 'leapfrog' the earlier stages offering increased choice in the development path and creating non linear path way. In addition the incrementalist model fails to recognise that unsuccessful developments in ICT may result in more than the delay of adoption of the next stage. Negative experiences may lead to retro steps, consolidating positive achievements in previously adopted stages. The paper hypothesises that the linear model fails to explain the historic development and further fails to provide a predictive model of future developments.

Introduction

A growth statge model of the development of Information and Communication Technology (ICT) has been used by a number of authors to project and suggest development pathways for ICT. This model implies a linearity of development and an inevitability of stage following stage. While this stage model may provide historic explanation for the development in the developed world and amongst the mature users, the model fails when used predictively for the developing nations or for the late adopters.

Growth Stage Model

Gibson and Nolan (1974) provide a growth stage model of the development of Information and Communication Technology (ICT). The initial model had four stages: Initiation, Expansion, Formalisation, and Maturity.

The S curve which Nolan had based on the growth in budgetary expenditure on computing reflected some evolutionary path with steps between each stage which Freidman (1994) identified as "likely crises in the organisation's experience of computers". This model was extended by Nolan (1979) to a 6 stage model reflecting a recognition that there were more sub stages reflecting the growth of knowledge and technology from the implementations. The model reflected not only a shift

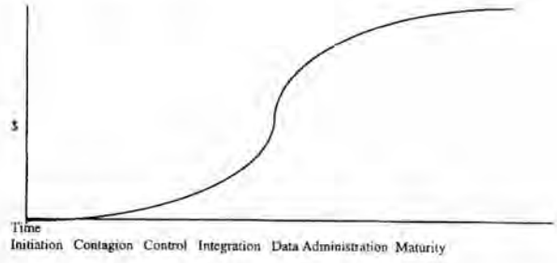

Figure 1 — Nolan's 6 stage model

in the objectives being sought but the involvement of management, the control and orientation of the evaluation. The revised model shown in Figure 1 demonstrates a balance between slack permitting growth and innovation while phases of control ensure cost effectiveness and integration. The rate of growth inferred in Figure 1 is quite gentle but for many the rate is explosive causing problems of control. The stages reflected distinct categories of evolution from batch processing through time share data processing, to PC's and networks of communicating processors with hindsight that may have been the experience of the larger US companies who had been involved with computers from the early days. This could not be described as the experience of the later entrants often SME's whose first foray into the arena came with turnkey and proprietary

software or the more recent entrants with commodity based PC's and software.

Freidman (1994) suggests that it is not purely a description but rather reflects a dynamic process embracing all of the stages and dictating their order of appearance. It is management's reactions to large scale and poorly understood technical events and organisational change. Freidman suggests the underlying emotional characteristics are:

- Caution when dealing with unfamiliar subsidiary issues
- Optimism that follows success
- Pessimism that follows disappointment
- Balance that follows experience of variations.

There is some evidence to suggest that Nolan's stage model provides categories that are identifiable. However the empirical evidence to this position support is lacking and the underlying time dimension as expressed in age of IS function does not correlate. Despite the evidence from, Drury (1979, 1980, 1983), Benbast *et al* (1984), the model continues to be used either explicitly or similarly: Galliers and Sunderland (1991), Jayasuriya (1993), Wastell and Sewards (1995) to project and suggest development pathways for ICT.

Freidman suggests the continued usage reflects:

- The only explicit model of time pattern of IS function development
- Clear and testable hypothesis
- Prescriptive content
- The model does summarise some experiences of organisations

Alternate Models

Nolan's Stage model inevitably suggests a product life cycle S-curve but perhaps the difficulty encountered with the model rests with the lack of separation of the individual technology life cycles from the long run product life cycle. If we select any phase within his model we find that he is incorporating several technologies some of which are in maturity, others that are only emergent and some which are expanding. This overlapping of life cycles confuses the long term trend as some technologies superseded stepwise changes, other technologies were additional (Figure 2). In the early

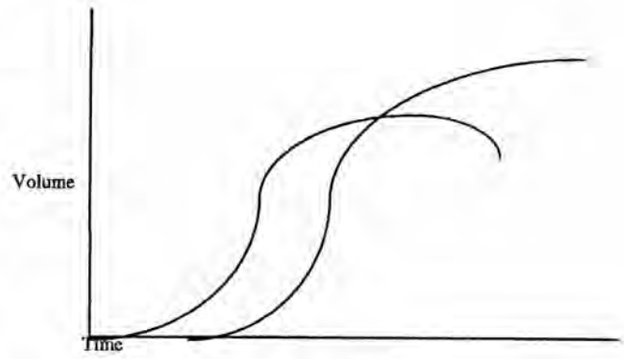

Figure 2 — Product life cycle S-curves

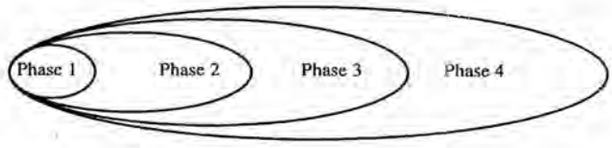

Figure 3 — Freidman's 4 phase model

phases certainly many hardware developments led to replacement but later complex networks developed with generations of hardware and likewise software.

One area where the proliferation of technologies may be found interworking is the office where office automation has not replaced but rather led to increasing varieties of technologies used to perform overlapping tasks. Only recently have we seen attempts at reducing the redundancy and integration of the technologies of printers, faxes, copiers and scanners.

Freidman with Cornford (1989) divided the history of Information Systems (IS) into a series of phases reflecting the domination of a particular problem that was seen as a constraint on computerisation. They separated the phases into hardware capacity constraints — until mid 1960's, software productivity constraints — mid 60's to early 80's, user relations — early 80's to 90's and organisation environment constraints — 90's to ? Freidman (1994) suggests these phases (Figure 3) may be seen as overlapping but with increasing stretch resulting in the shift in the location of IS control. He argued that at the boundary between the phases there

was mediation between the respective environments. This shift in control demonstrates how IS reaches out to seek to control and influence its boundaries as each problem or constraint is overcome.

All these models assume a linearity of development that is incompatible with the opportunities faced by later entrants into the technology. Okot-Uma (1988) presents a matrix to represent the varying levels of capability in information technology that exists between developing countries within the British Commonwealth. Such a model, reflecting Nolan's stage model demonstrates the need for suppliers to address the capabilities of users. Later entrants are able to 'leap-frog' the early development stages and gain access to the more mature technology but they still have to assimilate the learning from the early stages. This learning may be facilitated without the necessity to experience the technologies. They do not have to experience the associated organisational structure and task changes nor the primitive technology. The possibility of 'leap-frogging' suggests that access to technology as it develops should increase but evidence from North East Asia suggests that late entrants to the technology have not assimilated; rather dysfunctional divisions are appearing between the 'have's and have nots'.

Okot-Uma also introduces the concept of 'back-frogging' where technologies are prematurely deployed, and either negative experiences occur or there are problems in assimulation. In those circumstances not only can the technology fail but barriers to other new technologies may be created. A choice of "back-frogging", related to concepts of "appropriate technology" is presented as an equally necessary strategy to leapfrogging the competition. Perrin (1982) shows in an intriguing study that the Japanese were familiar with gunpowder and guns and had in fact developed them in the 16th century. However when the American traders forced them to open their harbours in the 19th century they had none. The Samurai's had banned firearms as unchivalrous, preventing the personal confrontation implied in warriors engaged in battle. This example along with controversy that exists around the western linear development and reinforced by similar examples of inconsistencies suggests that linear technology development is not a forgone conclusion.

Diffusion and Localisation

Institutional and technical aspects of diffusion of innovations in technology have been subsumed in the S-Curve representation discussed by Rogers (1983). Strang and Meyer (1994) distinguish between diffusion: "flows among formally autonomous unit" and implementation: "flows among hierarchically placed units". Organisations seeking to diffuse centrally developed systems must either accommodate intra-organisational cultural differences, or demand the end user groups adapt to the technology. This raises interesting questions for the movement of technology developed in one cultural context and transferred to another culturally focused context where the hierarchical controls may not exist to force the acceptance of the new technology.

Keniston (1997) discussed the software localisation process whereby software is localised through a process of initially retro fitting of appropriate user interfaces to more current practice of joint modular development of software with appropriate user interfaces. One respondent to Keniston suggested that "Culturally localized software is indistinguishable from software written by a member of that culture". While Keniston presents a strong argument why it is desirable for this assertion to be true, for North American domination of software to continue, the realities are that this is a false assertion and software written in one culture and adapted to the needs and outlooks of another will inevitably embody Cultural Imperialism.

Kaye and Little (1996) illustrate the problems of diffusion through two case studies and demonstrate how the diffusion from the developer and its adoption in context leads to adaptation and redevelopment leading to version drift and eventual incompatibility. Figure 4 presents two types dynamics of diffusion. In the first, an initial adopter, Organisation A undertakes a technical development on the basis of the needs of the organisation at time T1. This technology is deployed in the organisation at time T2 at which point the organisation itself has developed institutionally through interaction with its environment. In order for the technology, based on a snapshot of the organisation at T1 to be usefully developed the organisation must enter into a period of adjustment between the delivered system and the changed needs.

Organisation A reaches the beginning of its payback period on the innovation at T3. Organisation B, having observed A's process of deployment initiates its own development of the new technology at T3. In order to adapt the technology to their own needs they pursue a process of redevelopment followed by their own process

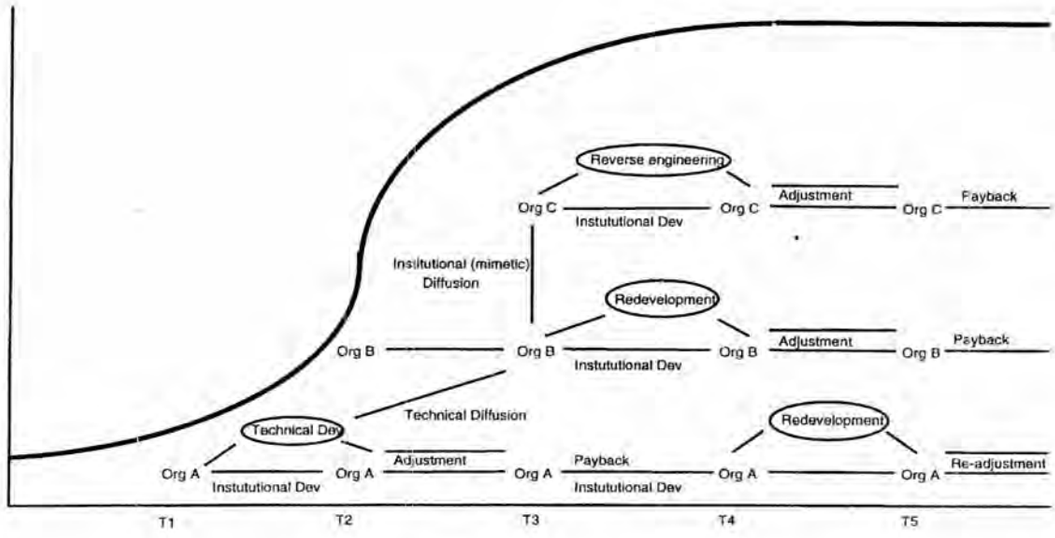

Figure 4 — Diffusion under the S-curve

of adjustment, so that payback for Organisation B begins at T5. Organisation C may follow the same development path as B but in this case it would trail technology or it may seek to mimic and develop at the same time as B. If this latter strategy is adopted then it will not be able to draw on B's experiences and must instead attempt reverse engineer which may achieve the earlier payback but has a higher risk.

This example demonstrates that linearity of diffusion may not always occur and localisation can be problematic. Localisation has problems of cultural barriers of which the most obvious is language that restricts access. Making the software culturally accessible places an additional translation cost in the system that may further raise barriers to access. These problems of localisation place a limit on the globalisation and universality.

Problems of Universality

Sachs *et al* (1997) suggest there are limits to convergence. Transportation costs associated with distance and physical barriers create economic limits and inequalities of income. The initial conditions, physical geography, government policy and demographic changes have been shown to influence growth in the period 1965-90. While specific policies such as openness of markets combined with regulation may overcome some deficiencies, the long term aspects of physical geography may limit growth.

Under free trade each country should specialise in those products in which it has relative advantage, however Matsuyama (1992), suggests that those endowed with good arable lands and natural resources might encourage agricultural growth at the expense of industrialisation. Evidence from the growth of Latin American countries suggests that economic growth can be achieved from both agriculture and industry by ensuring that not only does productivity rise in the factory but also on the farm. This increase in productivity can be achieved by increasing the value added from moving from production of fruit to say wine. However 'Engels' law suggests that as incomes increase the proportion spent on food will go down setting a limit on agricultural growth. This limit has a consequence on the distribution of incomes and may ultimately limit industrial growth if redistribution is not facilitated to avoid economic migration.

Rapid pace of growth in favoured area also creates regional imbalances while localised growth may cause instabilities. Ohmae (1990) argues for regional synergyies to maximise development regardless of pre-existing national boundaries. However the sustainability of such development is dependent on a balanced economy and any unevenness may result in internal, international or regional migration on such massive scales as to create instability. In the UK imbalances may be found between the forecast GDP for 1997 in UK being

shown as approaching 4 percent while Wales is closer to 1 percent and Greater London 5 per cent*.

The forces of globalisation and universality lead to two divergent models. In the first case the globalisation encourages the city state to emerge. This produces stronger cultural links to the international standards of exchange and trade with the reference group being similar trading groups elsewhere. Hence the universal language of business is English and the software classically American with Pizza's and burgers. In contrast the national identity is at odds with international trading. This disharmony reflects the cultural proximity (or distance) of the emergent global standards. The indigenous culture has strong roots and has evolved to complement the structure and processes of society. In contrast the exogenous culture may be distant both at the superficial level or at depth. In the case of western organisations the delayering and technological supports have enabled flatter organisations to emerge with short chains of command. In contrast China and Japan have long chains of command and strong hierarchies which permeate deep in to society and behaviour. This places these cultures as distant, which when applied to the context of say China lead to significant gaps between Shanghai's development and the average state of China. This creates tensions between the rural supportive infrastructure and the urban internationally referent city state. This divergence was not present in the industrial revolution as the developments took place within the same cultural tradition and context. Today we have two divergent reference groups.

Robertson (1992) uses the concept of relativization to represent the increasing challenge to particular perspectives on, and individual participation in the overall globalisation process. His model draws attention to the increasing interrelated thematization of societies, individual selves, international relations and humankind. He goes on to identify a temporal-historical path to the current circumstances: Germinal phase — nationalism; Incipient phase -homogeneous unitary state, formalised international relations; The Take-off phase - emergence of a single international society, increasing global communication; Hegemony Phase - international wars and emergence of United Nations and recognition of national interdependence; Uncertainty phase — concept of global consciousness further amplified by space travel, technological acceleration and multicultural societies.

Economist, 18th October 1997, pp 47.

Hampden-Turner and Trompenaars (1993) surveyed 1500 'upper-middle' mangers who had some international responsibilities. They found that managers from Britain, Holland, Sweden and the USA concentrated on individual self interest which when congruent with the organisational goals meant they would automatically serve their customers and society better. In contrast Japanese, French and German managers concentrated on serving customers and society which would automatically benefit themselves where the organisation pursued and rewards these ends. The relationships of the individual self interest, the organisations and customers or societies they saw as interdependent but fundamentally the value systems of the cultures were significantly different. However this oversimplification fails to portray how the cultures subtly vary and cannot be easily classified. Hampden-Turner and Trompenaars study led them to identify seven cultural values which underpin the alternative wealth creation systems (pp10). They characterise these values in the form of dilemmas where choices have to be made between the extremes

- Universalism v Particularism
- Analysing v Integrating
- Individualism v Communitarianism
- Inner-Directed v Outer-directed
- Time as sequence v Time as Synchronization
- Achieved Status v Ascribed Status
- Equality v Hierarchy.

'To say that the cultures of various nations "differ" on the relative importance of those values necessary to wealth creation is an understatement. Typically, these issues are loaded with ideological fervour' (pp11).

Rodrik (1997) suggests that those favouring globalisation underestimate the effect of free trade and capital flows which allow organisations to relocate production to low wage economies. The very threat of this causes insecurity and weakens established capital labour relationships. Further the quality of working conditions is more than a protectionist cry but reflects genuine concern for minimum standards of decency and reflect the lack of social insurance and the increasing burden on the state.

The drive for globalisation and international trade is excessive. While trade is inevitable and increases choice in providing economic advantage the drive reaches beyond this to imperialism and 'MacDonaldisation'.

Software systems may be carriers of implicit values and styles that may be alien or even subversive to other cultures. 'Localisation ' may be a response to this perception but this fails to recognise that the software assumes a cultural context at the design stage and this deep seated cultural value cannot be overcome by cosmetic redesign of interfaces. Keniston (1997) provided a review of the debate but this predominantly North American commentary fails to address the cultural conflicts of structure and processes. For Keniston the translation of software to allow for different character sets and right, left, or vertical scrolling reflects the industries' valid response given the importance of software to the US economy. However cultural dimensions reach far beyond the character sets of the user interface.

It is however important to separate software into the socially influencing and the technically dominant. The former are those for which the assumptions of organisation's structure and process as well as individual user interfaces are culturally sensitive, e.g. accounting and information system, groupware, etc. These contrast with the technical systems such as CAD-CAM where the cultural aspects of the interface are cosmetic and the underlying structure and processes are technically dependent and culturally neutral.

Further communications differ reflecting the cultural attributes of the respectives languages. Hall (1976) provides a clear split between:

High Context Cultures

> Much of the information being transmitted is in the physical and social context of the conversation; relatively little information is in the explicit message, communication is indirect, there is room for ambiguity and interpretation. People expect others to know what they mean - associated with collectivist cultures.

Low Context Cultures

> Most of the information is conveyed explicitly, directness is valued and little ambiguity, Expect clear and to the point information - associated with individualistic cultures.

Empirical Evidence from NE Asia and the UK

Japanese Factories have achieved world wide acclaim for their productivity and quality, their automation and technology, for innovation and market awareness. The high technology factories are in stark contrast to the office and administration systems. The factories use the latest technology of CAD/CAM, FMS, etc. to achieve World Class Manufacturing of the technologies that the West then utilises in the offices and administrative systems. Meanwhile the Eastern offices and administrative systems bring reminders of an earlier generation of western practices with large generally open plan offices with long rows of uniform desks with proliferation of calculators, telephones and faxes but few workstations or personal computers. Computers are shared and as such cannot easily be used for networking with e-mail and groupware products which now form the backbone of many western systems.

Graven (1994) describes Shiseido, Japan's oldest and largest cosmetic company's attempts for office automation. In 1957 it introduced its first IBM computer to track orders, plan production and handle logistics. In the 1970's it computerised its distribution system. However it still faces the challenge of office automation as it moves from this centralised information and data processing systems to distributed end-user computing where the individual user must interact through the technology.

The development of Facsimile transfer in Europe in 1890's allowed press reports to write remotely or draw facsimiles which led to the modern day electronic fax, which was jointly developed by Xerox and Magnavox in 1965. The adoption of this technology was most rapid in Japan (by 1985 an installed base of 850,000) where the telegraphic systems of communication had required either the adoption of English language or the development of a separate Japanese code language to represent Kanji characters. However the fax allowed the transmission of traditional Japanese characters thus overcoming the language barriers within the technology. The acceptance of Fax in US and Europe was much slower and the comparable figures for 1985 are 550,000 and 120,000 respectively. While many of those sold in the west bear Western brand names the bulk of manufacture was done in Japan.

During the same period 1981 to 1984 the sales of Word processing packages in the USA increased more than tenfold to approximately 2 million and by 1987 two of the more popular versions were selling in excess of 600,000 copies per annum. In a similar period the sales of faxes rose from 50,000 in 1983 to 295,000 by 1987. Word-processing was not only compatible with western culture but also business practices. The ability to send

text through teleprinters had been available from 1897 and while sending digital messages across networks was common practice there was some delay before wide scale usage of electronic mail emerged. In the meantime the fax could be used. This apparently retrograde step was a surprise to many technology forecasts who had expected the next step to be e-mail. However while the technology was available there were few wide area networks with the necessary capability to allow postal delivery of mail. The large scale development of Internet provided that facility internationally but within closed communities systems have been in use for a considerable time.

A recent report[1] suggests that corporate Japan is now commencing the wiring of offices which the USA undertook nine years ago. Sales of PC's have risen in the last 5 years from 2.2m units in 1992 to 8.3m in 1996 of which 5.6m were corporate purchases. Suddenly Japanese office workers have access to computing with 20 percent of desks sporting a PC. Most of these PC's have been used for Japanese word-processing reflecting the long awaited access to Kanji and kana character sets.

In recent months sales of fileservers to support network system and UNIX machines have increased by 89 percent in Japan which implies about 1/3rd of all PC's are networked. However the bulk of the applications appear to be for e-mail and some access to the Internet, replacing the fax and copier. The dearth of groupware products such as Lotus Notes or other application sharing and workflow systems available in Japanese are not the only delay as the hierarchical corporate culture of Japan discourages the flatter organisational style assumed in these technologies. Further limits are the lack of information managers and technologists whose specialist development is in conflict with the job rotation approach of Japanese management.

Until recently the most common language on the web after English was German. However, a recent survey by the Internet Society (1996) of a sample of the 30m computers with Internet address around the globe found that 82 percent of them were English; 4 percent German; 1.6 percent Japanese; 1.5 percent French; 1 percent Spanish.

Given the population distribution of the world and the languages and character set the data indicate a very uneven distribution between the alphabet based cultures and those using ideograms. However the rapid growth of networked PC's in Japan is rapidly moving Japan into second place. This reflects a move by the Japanese Ministry of Posts and Telecommunications to counter the American domination of this new technology.

Switching between Japanese and English is problematic as English requires only one byte to define the character while Japanese needs 2 bytes, (Chinese use a subset which can be accommodated within the 2 byte character set). While the solution has been to run two machines with different operating systems, new product launches of Twinbridge[2], KanjiKit[3] and Japanese Language Kit for Macintoshes[4] enable some co-working.

The problems of non alphabetic characters has been recognised for a considerable time and evidence from recent research highlights the complex problems. During the Edo period which ran from 1600 until 1868 Japan was a relatively closed society which was superseded by the Meiji period up until 1912. A survey during the early Meiji period suggested that only 4 percent of society were engaged in business and government and hence literate. Studies by Hall (1949) suggest much higher levels of literacy particularly amongst the merchants and 95 per cent of children in school by 1905. The rapid industrialisation of Japan in the early part of the 20th century saw various developments in the language and its processing. Historically the Japanese language was heavily based on the Chinese character set Kanji, but development in Braille using Hiragana (syllabic characters devised in Japan based on a simplified or truncated Kanji) and telegraph using Katakana (corresponding characters used for recently imported words) in the 1880's led to the development of the typewriter which not only used kanji but also replaced Hirangana (default characters cursive in style) with Katakana and led to horizontal writing and spaces between words. Romaji (Latin alphabet expression of Kanji) was devised in the same period by James Curtis Hepburn (1815-1911), a medical missionary who produced a dictionary of Japanese words.

Unger (1996) writing on Japanese script reform provides substantial insight into the development. During the Meiji periods rush to westernise, various reforms of the Japanese language were proposed and have continued (1850, 1873,1885, 1937, 1942, 1945, 1954, 1963) in this period, one has seen a shift from the government specified Kanji script of 1946, characters rising to 2669 before rationalising to 1925. Extreme views have

[1] Wiring Corporate Japan. *The Economist*, April 19th 1997, pp80-83

[2] www.twinbridge.com/

[3] www.pspinc.com/lsg

[4] www.macos.apple.com/multilingual

included complete replacement with English (Mori Arinori 1873), anti Chinese feelings seeking reduction or removal of Kanji and anti-western feelings seeking replacement of Katakana with Kanji. This reflects an early recognition of the problems of character sets and information and communication processing. Unger distinguishes between Phonographic (e.g. Alphabetic languages which may be phonetic) and Logograms (where the character represents a distinct word and hence is a cipher or code). He separates Chinese ideograms (symbolic of distinct thought and idea) from logograms but places them toward the Logogram end of the scale with Japanese closer to logogram. European languages such as French and Finnish are placed close to the Phonetic end with English approximating to that end. Experiments in 1948-51 with teaching comparatively between Romaji, and Kanji and Kana suggested that the latter were more effective than Romaji. Perhaps this reflects the deep-seated cultural aspects or the natural effectiveness of the evolved cipher system.

Benbast *et. al* (1984) suggested that the stage model was flawed and unsupported by the empirical evidence. Evidence from North East Asia suggests that late entrants to the technology have not assimilated but rather a dysfunctional division is appearing between the 'have's and have not's'. This division appears to be associated with cultural aspects suggesting that the assimilators have adapted the culture of the imperialist while the non-assimilators are disadvantaged by cultural barriers. But this dysfunctional division is not confined to NE Asia as evidence from the UK also confirms a bifurcation in usage and access to ICT.

The Motorola Report (1996) draws on a survey undertaken on its behalf by MORI of households and leading industrialists in the UK. The report characterises the nation as 'IT have's and have-nots'. The division exists on the basis of sex, age, employment and social class. Not only were the younger (16-44) administrative and managerial groups more likely to have access to computers in their work place but these same social classes were likely to provide access to computers in their homes facilitating educational access for the next generation. In contrast the lower social classes (C2DE) were more likely to be employed in roles where ITC had less impact on their daily activity, part-time working or unemployment further placed barriers in their development of IT skills...'caught in an IT void..'. This survey concludes that barriers continue to the adoption of ICT across the whole of society.

An IMF working paper by Slaughter and Swagel (1997) 'indicates a widening gap between the high-skilled (graduate and above) and the low skilled (secondary educated and below) in the USA and Britain, but less marked in other western economies. This gap has been explained in various ways, firstly 'low wage economies' drive down the unskilled rates, secondly that technological developments have boosted the productivity and wages of the skilled workers. At the same time theses economies have experienced recession with high levels of unemployment and increased part-time working leaving workers less able to negotiate a fairer allocation of funds between capital and labour providers. While the explanation for the gap may be disputed, all agree that technology can only increase the gap.

Recent events (October 1997) in the currency markets and stock exchanges of the ASEAN economies which have echoed around the world have raised questions over the continued expansion of these economies and raised doubts over the assumptions of inevitable continued growth of the region. While the return of Hong Kong to China may be identified as a starting point for the uncertainty the certainty of this return had surely been discounted in the markets. For explanation of this, we must turn elsewhere and again we are confronted with the problems of assumed growth paths as logical and inevitable development paths. The largest influence in the ASEAN region is caused by China which is not a member, China, but its effect on that region is enormous. For many years it has been signalled that China would be a source of significant economic growth with its 'new capitalist' developments. However the evidence is that in this period there is a significant slow down in GDP from 13 percent in 1994 to 9 percent in 1997* but this slow down takes place against a balanced economy with small current account surpluses and long term capital inflows.

IT Productivity Gains and Increasing GDP

The drive for globalisation, for universality and computerisation is frequently justified on the basis of economic gains and productivity improvements. However there has been evidence for some considerable time that ICT may not have enhanced productivity (e.g. Attewell & Rule, 1984; Buchanan & Boddy, 1983).

Landauer's (1995) survey of labour productivity growth measured as GNP per hour worked in the United States for the period 1870-1993 shows a stagnation

during the period 1950-73 followed by decline 1973-1993 during the period of large scale introduction of IT. Landauer concludes with neutrality that the developments in IT may have delivered positive net effects on work efficiency but these had not permeated through to enhanced productivity of the nation against other industrialised nations. During this period the workforce in the office had increased significantly (17.9 per cent in 1949 risen to 30 percent in 1976) while the proportion of administrative costs also increased dramatically. Early attempts to improve productivity as in the factory were primarily by reorganisation of work flow and fragmentation of tasks and achieved little. Later technological solutions have been tried but with little gain.

While some may argue that the expenditure on computers has been unwise, supported by classic failures such as the London Ambulance Service, a better explanation is that despite the impressive figures cited by Landuaer and others, the relative level of expenditure is insignificantly small (US estimated at 2% of total capital stock). This argument allied to the historical evidence that new technologies are slow in achieving productivity gains perhaps misses the growth in service industries much of which is computer dependent where separation of the service and the informational aspects are problematic.

This computer productivity paradox, has been examined (Roach 1985, 1992) at the micro level where even in industries where productivity growth had been achieved, output per information worker hour did not improve during the period of increased computer usage. However there was a significant shift from production workers to information workers, i.e. more in support role to enhanced production worker. In the service sector Roach found that productivity rose by merely 0.7 percent while investment in IT rose by 80 percent. Strassman (1990) was unable to detect any conclusive evidence of a positive correlation between business success (measured in return on net assets, return on equity, EPS, or EPS growth) and IT investment for the period 1977-87. The down turn in productivity can be better explained by increased global competition based around low wage economies which continues but has shifted location (NE Asia and Tiger economies replaced by Asian and East European sources). Further, these newer industrial economies invested in manufacturing capability and productivity rather than in supporting information technologies.

*SBC Warburg data cited in *The Economist*, p59, July 1997

Landauer's remedy for the "productivity paradox" is "User Centred Design" with its necessary counterparts of user centred development and user centred deployment. He puts forward a definition of desirability based on a combination of usefulness and useability as a means to defining and achieving more substantive gains from IT and presents definitions for user-centred design, user centred design methods and user centred development. Landauer (1995) extends his analysis to the issues of deployment which links technical design to a broader set of organisational issues. However, Landauer concludes with a statement that human mental capacity reflects not simply the capability of the individual, but also the wealth of stored human knowledge, and the power of shared mental tools. Such a framework offers a means of connecting the individual organisation and its wider cultural setting.

Conclusions

Given the global development of organisations and the dependence such developments have on ICT, it is important that we have both descriptive and predictive models of the development of ICT. Nolan's stage model has been a useful historical description of developments in large western organisations. It has failed to be proven and other models have provided explanations of the complex development paths available. Freidman's phase model recognises the constraints that limit growth and development. While Oko-Uma provides the possibility of both forward and backward stepwise developments reflecting both the opportunities faced by late adopters and the potential for both positive and negative experiences with innovation, the diffusion model also provides an explanation for adoption at varying rates and potential of discontinuous development of versions.

Globalisation encourages the belief or aspiration in software developers to universality and while certainly some evidence of 'Macdonaldisation' is perceivable at the superficial level, the underlying characteristic is of 'localisation'. However this localisation is frequently no more than the user interface and ignores the cultural assumptions embodied in the technical design. Not only does this superficial 'localisation' and underlying universality cause dysfunctional divisions between the host culture and the imperialistic, but this dysfunctional

division can go deep into society and the economical framework of the society.

This dysfunctional division suggests a limitation on growth and a non-linear development path. Such a restriction suggests serious economical as well as cultural consequences. Current predictions of growth based on ICT suggest no limits but the reality is that society is already dividing and the migration pathway between the two communities is increasingly difficult due to access barriers and cultural differences. The access barriers are primarily economic, reflecting the divide in economic benefit of development rather than the technical access issues as it is the same territories that have become the primary home of manufacturers of the technology. The juxtaposition of production of ICT resources in factories for which the office is still primarily manual with limited access to ICT emphasises the divide (Graven 1994) while the reality of the urban technology worker and the peasant economy of much of this region heightens the divide. In the former the access to technology may be exploited as the community adopts the western culture hence joining the global development path way. In contrast the rural community may increasingly be disadvantaged through lack of access and increasing cultural and economical barriers to entry. These conditions may be reminiscent of the industrial revolution but in the west agrarian developments were more harmonious with industrial developments. Today the rate of technological development in ICT is such that a dramatic gap may exist well within a generation.

The assumption of the neutrality of technology is flawed as it fails to recognise that technology develops in a cultural setting and consequently embodies that culture within its design. The developments in ICT are based on a western alphabet based culture that contrasts with the ideogram of the North Eastern Asian cultures (Shepard 1993; Haywood 1995). The development of the Qwerty keyboard and the encoding of the characters of the West (predominantly English) in the design of 8-bit and ASCII characters within 101 keyboard do not easily support the Chinese characters nor their embodiment of the ideas and culture of that society.

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