Conquering the Frontier: Developing Human Resources for ICTs in Papua New Guinea.

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Introduction

Rapid advances in technology, especially information and communication technology and multimedia have provided the foundation for transforming existing social and economical relationship into an information society. Today there is increased and exponential growth in the production and dissemination of information that many see as an advent of an 'information society'. Information is therefore a crucial resource and essential to national development in today's knowledge society. Information related work usually includes information and the Information Technology industry, education, research, the media. Information is critical to everyone and essential to research, development, and consultancy whether scientific, technical, economical or social.

The development of the Information Society will ultimately depend on its underlying infrastructure. African and Asia Pacific nations are focusing on policy's concerning Information and Communication Technology infrastructure, underlying the future Information Society. PNG has done very little to invest in infrastructure nor attempt to develop its ICT human resources. Human and institutional capabilities are extremely important for the development and use of information systems and contents. With this view, life-long learning, education and training are considered to be important as they develop and enhance the capability to process, analyse and transform information into useful knowledge (Audenhove et al., 1999). Developing countries must continue to develop the ability and capacity of their human resources to sustain the growth of ICT and knowledge industry.

We discuss issues relating to knowledge economy, the significance of developing human resources and importance of developing and establishing a policy framework for ICT growth in LDC's. We also discuss the IT/IS education and the need for IT/IS curriculum relevant to the country's requirements. Finally we postulate a set of underlying principles for an IT/IS education model suitable for LDC's in particular, PNG.

ICT industry in PNG

The most appropriate technology for any country, industrialized or developing is the one that makes optimal use of existing resources - human, material and financial. Digital convergence is increasingly tying computer technology to telecommunications and broadcasting. The convergence and fusion of different technologies like media, computers and telecommunication have underlined the urgency for change. It is for this reason the definition of IT industry used in this paper is broad, encompassing telecommunications and electronic media. It could be argued that some of the industry sectors do not deal exclusively with IT even under this broad definition. However the Information Technology industry includes the development and application of computers and communications-based technologies for processing, resending and managing data and information; computer hardware and component manufacturing; computer

software development and various computer related services; communications equipment, component manufacturing and services.

Current industry trends are for growing acceptance of online trading, an expansion of Internet commerce, increased tendency towards small home offices, and an increased demand for client support services. Information storage and retrieval, and network administration are areas in which growth is most anticipated. LDC's emphasise the need to develop information infrastructure (Cornella, 1998; Audenhove et al., 1999). Most of these countries have little or no infrastructure in place to cater for their requirements to function in a global context. If there is infrastructure in place, it is limited to small regions, usually in the capital cities. IT policy and guidelines should be formulated and implemented to develop ICT infrastructure for sustained ICT growth.

In PNG initiatives are being taken to boost the ICT industry. One of these is to liberalize the telecommunication sector (Waieng, 2000). The telecommunications network in PNG is owned by the Government and operated by its statutory organization, the Post and Telikom Corporation (PTC). PTC is the sole telecommunications carrier.

Internet was first introduced to PNG in 1997 and currently 5 Internet Service Providers (ISP) provide online Internet and email connections. There is no IT manufacturing industry, although one IT company, assembles computers with parts imported from Asia or Australia. Most computer hardware and software are imported from Asian or Australian markets, thus relying on foreign IT industry. Hardware sales and service increased in recent years, however service and support in most cases are unreliable. Similar to other developing countries, cost of living, telecommunication services, electricity and air travel, are high. Therefore only a small percentage of the population own personal computers, thus Internet access is extremely low. The internet and relating industry in PNG is slowly developing, however only in private and multinational organization (Waieng, 2000). The public sector is not a major user and Internet use is hardly found in homes. Apart from a handful of tertiary institutions, internet services are virtually nonexistent in primary, secondary and tertiary institutions (Waieng, 2000)

Knowledge Gap
There is wide shortage of Information and Communication Technology (ICT) professionals throughout the world, in particular Least Developed Countries (LDC). The demand for IT/IS professionals far outweighs their current availability. Human resource may be the single most important element in successful ICT diffusion for many LDC's. In PNG as more private and government implement IT there is a growing demand for skilled IT/IS personnel. Due to the rapid changes in Information and Communication Technology, computer systems and software are rapidly becoming outdated, making an individual's knowledge quickly

obsolete. Policy makers, generally see the education system, as the vehicle by which IT/IS professionals are trained and prepared to meet industry needs.

Emphasis is now placed on educational institutions to produce skilled IT/IS professionals to meet the demands of the changing world. Thus the aspirations and requisite capabilities of any advancement would only be possible with the continuing drive to develop IT/IS professionals, not only in terms of quantity, but also quality (Loh, Sankar and Yeong, 1995). Skill sets change because there is continued change in industry perspectives and demand due to the rapid changes in technology and the current shift towards globalization.

IT/IS professionals in industry and educators often tend to function in a vacuum, each group having a different perspective of the workplace (Pham, 1997). Thus it is common for employers to argue that university graduates possess general computing knowledge but lack specific skills that industry requires (Pham, 1997).

Employers emphasize technical skills and competency to immediately cater for their organizational needs, while educators advocate problem solving, analytical thinking and research. Educators argue that in skills and competency-based programs, graduates scope for learning is narrowed, as the programs often lack fundamental and analytical knowledge and function at an abstract level. Furthermore educators advocate that the main goal of higher education is not vocational training where the focus is to produce specialized and skilled IT/IS professionals, but a wider context that includes emphasis on theory and research. However educators in PNG take a different perspective for PNG by arguing that more emphasis be placed on developing technical competency, Salt (1988) and Ryan (1994). Ryan (1994) argues that curriculum content to an extent should cater for the local ICT industry with an emphasis on technical skills and business orientation.

For PNG, the expectation gap, (Pham 1997), must be narrowed with a leniency towards the emphasizing technical skills. Ryan (1994) suggested that IT/IS graduates are occupying higher technical positions in organizations in PNG and were not practicing the acquired skills.

Developing curriculum by educators in collaboration with industry could fill this gap[1]. For example, universities in America have been implementing curriculum models developed by professional groups since 1970. Recently in Information Systems, the 'IS 97 Curriculum Model' developed by Association for Computer Machinery (ACM), Association for Information Systems (AIS), and Association for Information Technology Professionals (AITP). The 'IS 97 Curricula Model' is under review to be upgraded to 'IS Curricula 2001 Model'. Curriculum developed by educators in collaboration with industry and other stakeholders seems appropriate to educate and prepare IT/IS professionals.

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[1] The authors acknowledge that the existing gap can never be completely bridged. Nevertheless being aware of the different perceptions in designing IT education models can lead to narrowing the gap.

Information Policy

Cornella, (1998:3) describes information policy as a 'set of public sector laws, regulations and policies that encourage, discourage or regulate the creation, use, storage, communication and presentation of information'. A goal for any information policy is that it should correct some default that presently exists in that area over which control is sought. Information policy provides a broad framework within which the wide range of information-related activities undertaken by public and private industry can be reconciled. Also, Information policy covers a wider range of portfolio boundaries thus recognising a wider range of policies, principles and practises. Any nation with serious policies for economic, social and cultural development thus needs complementary policies to ensure the supply and use of information. This approach is crucial given the universal importance of information and the rapid growth of information technology. Perhaps most importantly information policy emphasizes the importance of drawing towards information intensive information society. Also the development and implementation of any information policy is not the sole responsibility of the government but a concentrated and collaborative responsibility on the part of many organizations. Cooperation and coordination is necessary for the national focus between organizations, central and local governments, association's of information users, professionals and the information industry.

Common elements of information policy are, identifying the information needs of the nation, devising ways of achieving these needs and promoting effective use of the resulting services. Information Policy covers a wider scope in both public and private industry that may already have policies or are developing policies. These areas include Communication, Library, Broadcasting, private sector, Information Technology, education and training, primary industry, health services and education. A combination of policies, acts of parliament, and strategies can form the basis of a National Information Policy(NIP). ICT implementation in most developing countries have been sporadic and on ad hoc basis epitomizing the lack of policy framework and direction. Sinebare (200) suggests the classification of developing countries based on the existence accorded to Information Policy. According to Sinebare(2000), they are: *non-existent Information policy, Implicit information policy* and *explicit information policy.* While many countries have identified and developed information policies for the ICT industry and because of the globalisation effect, few countries could be classified as *non-existent.* Developing countries such as Korea and Singapore have explicit Information Policy where the government plays an active role(Sinebare 2000). However in countries where governments are active participants in ICT they have an implicit-information policy. These countries include Malaysia, Sir Lanka, India and Pakistan. They work under auspices or government organizations such as the IT Council of Sri Lanka or Department of Electronics in India (Sinebare 2000). In most LDC's there is economic and political instability resulting in an economic environment less conducive to ICT growth. Therefore political leadership and

direction is also critical in the process in a holistic manner in relation to the country's economic growth enabled by ICT. The capacity to implement and use ICT requires a pool of computer literate professionals. Thus the success of any IT vision of any country rests on maintaining a competent base of IT/IS professionals with strong technical capabilities (Loh et al., 1995). For this reason, education and human resource development is singled out first in most IT policy frameworks (Loh et al., 1995).

IT/IS Education

For any country to underpin their information economy, it is important to develop the intellectual infrastructure. Education adds information to people, thus increasing their economic value. In PNG the government has been reluctant to introduce IT education in to Secondary and National High schools highlighting lack of fund and teacher support and resources (Sinebare, 1999). Private training organizations run IT related course at an ad hoc basis primarily in user application packages. Sinebare (1999) highlights many other implications and recommends for the development of an IT framework to streamline the discrepancies in the development of IT human resource in PNG. In PNG, a survey was last conducted in 1988 to determine industry requirements for the IS curriculum at the PNG University of Technology (Salt, 1988). A review of the course was than initiated and a new course structure was developed and implemented based on the ACM 78 curriculum model. Alterations were made to the course over the years to cater for the changing industry needs in PNG. The 'IS 78' model was superseded by 'IS 97' (which is currently under review to be upgraded to 'IS 2000' model). Among our respondents in our recent study, concern was expressed about the lack of substance in the curriculum content, and that academics were teaching units not specified in the syllabus approved by the University's academic board. A significant challenge as noted by (Thoeuri and Gunn, 1998:103) is "the need for educational programmers to constructively adjust curricula in order to remain a relevant force for providing employers (business and public) with better qualified employees".

Many researchers (Thoeuri and Gunn, 1998) have raised concerns by employers regarding preparedness of entry-level professionals. Poor University programs, lack of ongoing training for employee and the rapid phase of Information Technology have resulted in the lack of skilled IT/IS personnel. The importance and role of developing better curriculum is significant to bridge the skills gap between the rapidly changing technologies and industry needs. Universities should provide a conducive learning environment and industry oriented curriculum that the business community perceive as meeting their needs, particularly in IT.

Curriculum

Curriculums are developed with the objective of producing skilled and employable graduates. As stated by Ching, Glorfefld and Lam (2000), employability rests in the knowledge and skills imparted upon them through their

education. In recent years there has been a major paradigm shift in IS where their role may have changed from providing or acquiring IT resources to managing and facilitating. Thus organizational skills such as, communication and understanding business have began to take precedent over technical skills (Leitheiser, 1992; Ching, Glorfefld and Lam 2000; Lecth and Randolph 2000).

Leitheiser (1992) and Porter (1985) posit that several external factors determine how an organization applies ICT. The challenge for academia is to understand the factors that influence IT and how these factors shape the required skill set. Using the skill set to develop IT/IS curricula to prepare graduates pertinent to organization requirements.

The designing of a curriculum directly influences the quality of the graduates and their employability. Many Universities have developed or adopted curriculum models considered relevant for the industry and available teaching resources. For example, in the Information Systems realm, a curriculum model, "IS 97 model Curriculum and guidelines for undergraduate degree programs" developed by ACM, AIS and AITP societies was implemented for American and Canadian Universities. The model curriculum is based on undergraduate degree programs in the USA and Canada. The model can be employed as a referenced material for internal use. ACM also includes Computer Science and Data Processing models. However these models may not be suitable for LDC's like PNG because of the disparity in student entry level and program background. There are other issues such as finance, subject expertise and technical resources, political, social and economical instabilities that hinder developing countries to fully adopt these models. To cater for local requirements, Ryan (1994) suggests the need to decentralize curriculum models. A refined version of the curriculum models with relative content suitable for local conditions could be implemented in Higher Education Institutions in PNG.

The notion of global business practice has further challenged IT/IS educators in educating and preparing IT/IS professionals where the workplace has 'no boundary's'. IT/IS professionals are facing new challenges of workplace paradigm shift where no longer are they confined to their four walls

PNG Skills and Capability Study
Addressing curriculum review and update within a planned time frame is necessary considering the rapid changes in ICT. IT/IS professionals are required by industry to possess skills and capabilities that will propel their organizational growth. Preliminary results from our recent study (Kelegai, L. & Middleton, M. 2000) indicate that PNG IT professionals place a high emphasis on non-technical or 'soft' skills as indicated in the table below. Interpersonal skills also rated highly.

Operating systems and programming language groups (technical skills) scored relatively low. Weighted average was calculated by determining the sum of

frequencies of each scale in each skill group question multiplied by the weight (1-7) and divided by the sum of responses.

IS Skills Aggregate Weighted Average Rating
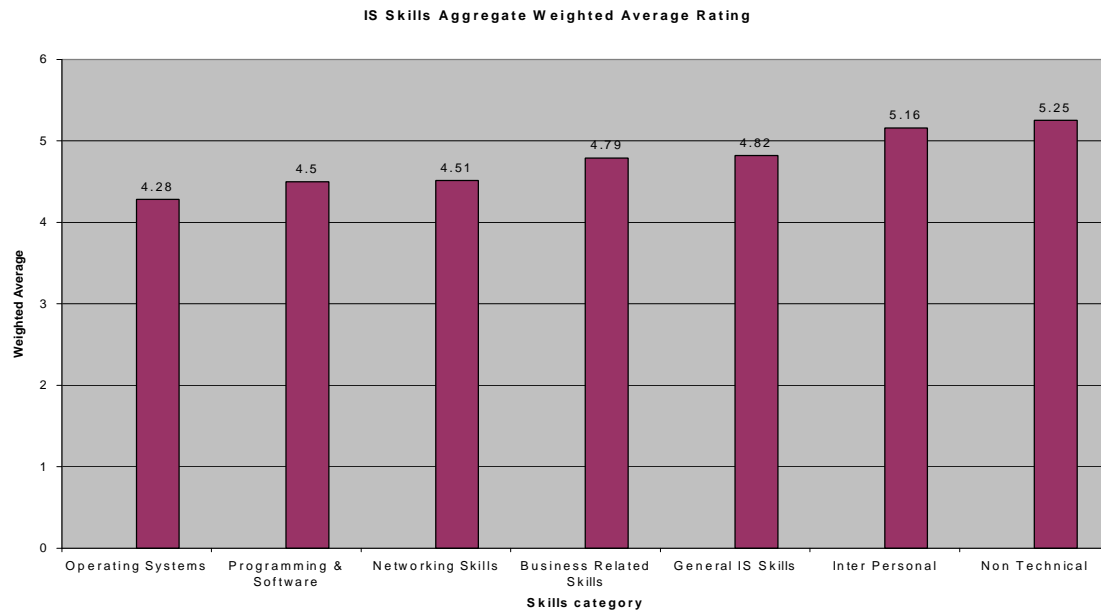
Figure 1: Skill groups aggregate Weighted Average rating taken from (Kelegai, L. & Middleton, M. 2000)

The results correspond to similar studies conducted in the USA and Australia (Von Hellens *et al*, 2000). Despite the significant differences between USA, Australia and a LDC like PNG, the results indicate common perceptions. For example, non-technical skills was given the highest ranking followed by personal skills in the study by Von Hellens *et al,* (2000). Technical skills groups, programming and operating skills were given relatively low rankings.

IT Education Principles
We postulate several principles that underline the basis of the IT/IS Education Model suitable for PNG and other LDC's.

IT/IS Education Model should;

(a) *primarily be focused to cater for the ICT industry in the country and gradually looking outward.*

(b) *be planned, coordinated and developed in accordance with IT, Education, Economic policy and framework.*

(c) *produce skilled IT professionals with a mix of theory and technical skills with an emphasis on life long learning.*

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(d) *have multiple exit and reentry points that encourages industry experience and individual development.*

(e) *consider social and cultural issues in the curriculum design.*

(f) *have a control and audit mechanism that should constantly provide feedback for review.*

Conclusion

ICT is a phenomenon if harnessed properly can propel Papua New Guinea into the information society. The development of skilled IT/IS professionals should be a priority for PNG for sustained growth in all sectors to enhance the ability to participate in the global economy. Smart partnership is required between government, private sector and educators to develop ICT human resources in the country. Therefore several underlying principles are postulated to develop an IT/IS education model suitable for Papua New Guinea. Political and economical stability and the recognition of ICT has an enabler at the highest government level is also important. Government initiatives such as developing policy and strategic guidelines remain significant ingredients for infrastructure development for the growth of the ICT industry.

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