World Report on TVET
The promise and potential of ICT in TVET

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Commonwealth of Learning

"*ICT, and ICT alone, has the capacity to provide the means by which the widely-used concept of lifelong learning has an operational meaning. Without it, the notion is little more than a noble aspiration. Without ICT, concepts like equal access to education and education for all are condemned to the fate of a slogan: however right they may be, without the means to share the knowledge generated by formal and non-formal educators, they can never be more than an empty call to promote equity and justice.*"

Dendev Badarch
UNESCO IITE Director a.i.
Foreword to E-Learning in the Republic of Korea: 2010

1. Introduction

We have started with some powerful words from UNESCO IITE concerning the promise and the potential of ICT in lifelong learning. This chapter of the World Report considers the global evidence for the efficacy of the use of ICTs in the delivery of technical and vocational education and training (TVET). During the last decade there has been increased focus on the use of ICT for the management and delivery of TVET in both developed and developing nations. Countries are in different stages of development from the industrial to the information age and are establishing strategies to reform TVET to meet the changing demands of the knowledge economy. The concept of knowledge economy is used here to mean "an economy where knowledge is the main engine of economic growth" (Chen & Dahlman 2005). This is a position to which many countries, both developed and developing, aspire. The European Union's strategic goal, agreed in Lisbon in 2000 was that ten years later, Europeans will live in the most competitive, and dynamic knowledge-based economy in the world. Many countries expect the ICT revolution to spur their economic development and transition to knowledge economies. The knowledge economy is underpinned by information technology – those systems which collect, enhance and commodify knowledge to support high value services and processes. In parallel, a wider 'knowledge society' is expected to develop, with knowledge being used to improve public services such as health and education.

The importance of digital literacy or ICT skills for economic growth and global competitiveness is well documented (OECD, 2003, 2010; World Economic Forum, 2009; GeSCI, 2011; Chinien, 2011). It is claimed that the digital revolution will reach parts of the world which were not reached by the agricultural or industrial revolutions (WEF, 2009). Development partners such as UNESCO, COL and GeSCI are committed to the use of ICT to deliver TVET in both formal and non-formal settings and are working with countries to support national TVET objectives. Technical

> Information technology and the Internet are major drivers of research, innovation, growth and social change. OECD 2010

assistance from development partners has been instrumental in expanding the use of ICTs in TVET in many developing countries, particularly in Africa, central Europe and South America.

This chapter of the World Report on TVET is both a retrospective on how different countries have employed ICT in TVET systems in the past decade and a consideration of the potential for ICT in the TVET of the future. Some of the drivers for the development of ICT in TVET will be discussed. We propose that the use of ICT in TVET is not only about technology, but that if the true potential is to be realised, new pedagogic and organisational approaches are needed. Finally, we will consider the lenses thorough which innovation can be viewed and attempt a synthesis of the potential or actual contribution of ICT in TVET.

Terms used in this chapter

Working definitions of the myriad terms used in ICT in TVET are given as Annex A.

About the authors

The authors of this chapter have worked in ICT in education and TVET for more than 20 years. They are currently involved in the Commonwealth of Learning Flexible Skills Development project in Africa and other flexible and elearning projects in TVET in the Caribbean, Pacific and Asia. They are proponents of the use of ICTs, or educational media and technology, in flexible and blended approaches to technical and vocational education.

2. The drivers of ICT in TVET

The challenges facing technical and vocational education and training in the twenty-first century demand learner-centred innovative and flexible approaches (UNESCO 2002). ICT is now considered by many governments as a critical component of a responsive, demand-driven TVET system tasked with meeting the needs of learners for more flexible individualised training. This is particularly evident in Australia, Korea, the USA and Europe. The challenges facing TVET systems are well documented and will not be rehearsed here but we will highlight five commonly accepted drivers for the development of ICT in TVET – the requirements of a knowledge economy, the increase of ICT in the workplace, the demand to increase access to initial vocational education and training, the lack of qualified teachers and the requirement to provide opportunities for continuing professional development, re-skilling and skills upgrading.

TVET for a knowledge economy

There is much similarity in the policy rhetoric of both developed and developing nations about the knowledge economy, although the underlying rationalisation is different. Developing countries, particularly in Africa are not moving from an industrial base being depleted by the growth of the tiger economies of China and India, nor do they have the economic concerns of an ageing population. The OECD suggests that two thirds of the population of sub Saharan Africa is under 25 years and up to 90% of employment is in the informal economy (OECD 2009b).

People in Africa work predominantly in the informal economy and this is the destination for most young people completing basic education. And yet, the knowledge economy has become a significant driver of TVET policy, partially in response to the emergence of a 'knowledge divide' (Chen & Dahlman 2005). Analysis of ICT policies shows that developing countries which are still predominantly reliant on agriculture and primary industries, aspire to become knowledge economies. Consequently, formal TVET, across

the globe, is now expected to provide graduands that have a much broader set of competences, beyond those traditionally required for employment in the pre-knowledge economy age. TVET institutions and their teachers are expected to 'transform' into collaborative, responsive, learning organisations to reflect the operating agility required by businesses within the knowledge economy, with ICT seen as the key element. This is a far cry from the actual needs of the large majority of informal economy businesses where productive skills are the difference between a meaningful livelihood and poverty. Nor does it adequately address the imperative needs of the agricultural economy.

In many developing countries, it is difficult to justify ICT as a driver for change in TVET based upon aspirational notions of a formal knowledge economy. However, if the perspective is changed to the development of a knowledge or information *society*, where ICT can be seen to improve social services, access to education, the development of civil organisations and services, then we can make more sense of the question – Why ICT in TVET for developing countries? In Botswana there is no specific ICT policy for TVET, but is subsumed within the national ICT policy *Maitlamo (2004),* which is a broad statement of values and intent to improve the economy through a range of interventions in health, education, public services and support for e-commerce and consumer rights. This is a much more compelling driver for institutions and the people who work in them. These are values and aspirations they support unreservedly, and a far cry from the alien concept of a knowledge economy they are not part of and do not understand.

An evaluation of ICT in initial VET in Europe in 2005 showed that almost all the member states are emphasizing the integration of ICT into TVET and/or the education system in general. However, the extent to which this is being implemented varies. It is a major priority for UK, Austria, Sweden and Finland where national funding reflects the political rhetoric. The authors note that a lack of national policy and strategy does not mean a lack of elearning initiatives. Their survey showed that "*the development of IT and e-learning in iVET institutions is closely connected with broader issues such as the evolution of the information society, the lifelong learning paradigm and the general development of secondary education."* (EU 2005).

In 2002 Haddad and Draxler proposed that a new ICT-enhanced model of education is needed for the Information Age as the current model of classrooms, contact teaching and full time programmes was designed for a previous era – the Industrial Age. "*The education model developed for the Industrial Age cannot achieve educational empowerment effectively in the Information Age*." (Haddad & Draxler 2002:8) The need is for a paradigm shift in the way we think about providing education and training.

This view is echoed by Hampton & Bartram (Mishra & Bartram 2002:63) "*If access to TVET is to increase, new ways of developing and delivering courses must be explored. TVET must be taken outside of the classroom and into the communities, the workplaces and the homes of the students. Traditional ways of thinking about TVET must be put aside and different ways of packaging and delivering knowledge and skills must be developed*." Through working with TVET institutions in 6 African countries, we believe that it is ICT and more flexible and delivery blended approaches that will enable TVET to be taken into the communities, workplaces and homes.

> "In the last decade, the changes in the Australian VET sector and the accompanying changes in the delivery of education and training have coincided with rapid developments in technology."
> Brennan et. al. 2001

This shift has already taken place in government thinking in countries like Australia and Korea, where government policy frameworks have been widespread and the supporting financial investment has been substantial. Kearns reports that in 2000, the Australian TVET Action Plan 'Flexible Learning for the Information Economy' was influenced by the '*profound transition from the old mechanised economy to the new information economy*.' (Maclean & Wilson, 2009:1961) In Australia it was considered critical that TVET should use the tools of the new economy and accelerate the pace with which new technologies were applied to TVET. Alongside this was the idea that flexible learning should be seen as a change process and thus the agenda was set for the five year national development programme implemented under the Australian Flexible Learning Framework (Australia DEST, 2000).

In Africa, at the institutional level, technical training institutes and polytechnics are slowly building staff capacity and technical infrastructure to offer TVET with more flexible and blended approaches. However, enabling policy and funding is still to catch up with these developments (Mead Richardson, 2011). In South America and the Caribbean, CINTERFOR report that vocational training institutions in the region have made great advances in adopting new training methodologies using ICTs, focusing on both quality assurance and innovation in learning spaces (CINTERFOR, 2008). A survey carried out by UNESCO in the Arab States at the beginning of the decade indicates that five Arab nations (Egypt, Morocco, Emirates, Kuwait, Saudi Arabia) show strong strategies and plans for using ICT in TVET with a further seven States (Bahrain, Oman, Yemen, Lebanon, Libya, Sudan, Mauritania) also articulating some aspect of the use of ICTs.

The new knowledge economy is driving the transformational strategies of developed and developing nations but evidently at different rates and with different characteristics. New models are required for the way TVET is organised and delivered partly to increase access and improve quality, but also to transform skills training to meet the changing demands for ICT skills in the workplace.

ICT in the workplace

It is recognised that the formal TVET sector is required to be responsive to a continuously changing labour market and new emerging business sectors that are often technology intensive. "*Flatter hierarchical structures, and devolved decision-making, initiative and control, also widen the need for higher-level skills and training, and result in increased responsibility for workers. ICT is accelerating these management trends and changes in the world of work in general"* (UNESCO, 2002:61). TVET systems need redefined policy approaches and strategies to deliver appropriate curricula to meet these trends. This is problematic. Even in developed countries, the ability of government ministries to collect the labour market information that is required to understand trends and changing needs is not always available or timely. There is often no corresponding budget for training and retraining of existing TVET teachers to meet new strategic aims as they arise. We return to the challenge of TVET teacher upgrading later.

> "TVET institutions must develop the workforce skills needed by the new and emerging industries of the information economy".
>
> Australia DEST 2000

Governments and employers are contending with the need to identify competencies and standards for ICT. The Canadian government commissioned a study of digital skills with a view to developing a set of digital competencies for the workforce similar to those in place in Australia and New Zealand. Chinien notes that digital skills development is currently the number one economic recovery policy in the majority (15)

of OECD Member States, and it also ranks number 6 in their long term economic policies. Additionally, due to increased demands from the knowledge-based economy for processing large amounts of information, it has been established that working with digital systems and tools to perform most job tasks involves complex cognitive and metacognitive skills, over and above the basic ICT skills for using software (Chinien 2011).

This reflects a period of fundamental reappraisal of how the process of learning is to be framed. Constructivist theories are now supplemented by concepts such as Siemen's connectivism and connected intelligence, reflecting the pervasive social interaction and connected information of the digital environment. The experiential, project based, problem solving approaches now advocated, places much less emphasis on content and much more on the processes of locating and critiquing information. During this process, learners learn *how* to learn. Learners are required to create knowledge rather than just assimilate it.

The TVET curriculum has traditionally been highly specified so that industry can know what a qualification implies, what a prospective employee will be able to do. Competency based training (CBT) approaches are often finely specified in terms of outcomes, criteria and assessment evidence. The structural emphasis has been on modular content with little flexibility for cross curricular activities. While it is possible to use constructivist, project based approaches with a competence based curriculum, many developing countries struggle with a lack of competent assessors able to apply discrete performance criteria standards without the added complexity of disaggregating individual performance within a project.

The increasing application of ICT in industry and business has created a dynamic workplace environment that TVET institutions must try to simulate in the delivery of the curriculum. ICT has pervaded every workplace to the extent that ICT skills upgrading has become a major training business in its own right. TVET institutions responsible for pre-employment training need to cover this skills requirement as they do all other technical and professional skills required by industry. This also means re-equipping the current workforce with the skills required to keep up with this new reality (International Labour Office 2011). Continuous innovation through technology means that institutions must have structures that support continuous development and change processes. This includes new organisational structures, new qualifications structures, and ways of describing and assessing skills. In addition, competency based approaches, modular and credit based systems and flexible management and leadership of both physical and human resources are required.

> "ICTs have a central role to play in bridging the TVSD learning environment to the world of work. With increasing outreach of infrastructure and connectivity and constantly declining costs for equipment ICT integration to TVSD is within reach."
>
> GeSCI 2011

Increasing access to initial vocational education and training

Increasing access to initial vocational education and training has been a feature of government policies globally. (EU, 2000; Australia, 2000; Botswana, 1997; Ghana, 2003; Kenya, 2005; Hwang et.al., 2010).

There are no direct references to TVET in the Millennium Development Goals but the success of governments' and development partners' in achieving these and the first Education for All goal of Universal Primary Education have caused considerable pressure on post basic education and training systems. This extraordinary growth in young

people exiting secondary education creates a demand which cannot be met by bricks and mortar approaches and is a feature of TVET systems in developing countries – especially Africa. The Association for the Development of Education in Africa (ADEA) characterises African TVET systems as having "*huge numbers of poorly educated, frustrated and unemployed youth who are 'locked out' of the formal skills training system and unequal training opportunities fostered by inequities based on geographical location, gender and socio-economic factors"* (ADEA 2010). A new model is needed and that will include ICTs used in flexible and blended approaches. But it is here that TVET systems in developing countries suffer a double blow – they have insufficient numbers of qualified staff, many without formal teacher training, but are now considering expanding access to VET programmes by venturing into elearning, integrating educational media and technology with, what is for many, an alien pedagogy. There are few examples of pre-service teacher training institutions, able or ready, to integrate ICT into the teacher training curriculum. Many teachers study by traditional distance learning modes. These systems are slow to change.

The lack of physical access to full-time, college-based VET for all the young people exiting secondary education and needing initial skills training can be mitigated by more flexible, technology-enhanced programme offerings. GeSCI suggests that TVET should "*incorporate ICT to increase access through enabling new learning pathways. Opportunities to expand enrolment to TVSD can be seized through ICT enabled blended learning methodologies that complement regular TVSD course offerings. Flexible and modular TVSD opportunities can play an important role in bridging the skills gap recognised by many growth sectors."* (GeSCI 2011:8)

Countries as far apart as Botswana and Estonia report that for every TVET place offered 10 young people apply. In the case of very popular courses like Business Studies, there can be more than 100 applications per place. But issues of access do not always relate to pure numbers. The TVET context and student profile is important. There are also issues of access in Australia but they take a different form due to the learner profile. ANTA indicates that training made possible by technology has the potential to address inequities of access, so long as issues of infrastructure, costs, instructional design, learning support and cultural relevance are also addressed (ANTA 1998).

> "With ICT tools, we should be able to evolve the components of the conventional model into the corresponding components of the new mode."
>
> Haddad & Draxler 2002

Again, the model proposed by Haddad and Draxler becomes relevant. To meet the current access demands for education and training, we cannot rely on linear scaling - that is, using the same model of education (a school constrained by space and time) but more of it and on a larger scale. These authors urge us to think differently and radically; we need new models that utilise the benefits of ICT to lead to classrooms without walls. The development of outreach centres can also contribute to the new model but the number of institutions with outreach centres is currently very low. In TVET institutions in African countries such as Kenya and Tanzania, consideration is being given to the establishment of outreach centres which offer programmes through flexible and blended approaches. These include the use of distance learning through a variety of media and technology, blended with some contact sessions. These initiatives are exposing the challenges that institutions face as they attempt to implement appropriate *operational models.* The management and operational culture of TVET institutions in Africa lacks responsiveness and has no 'track-record' of supporting innovation. The administrative systems are strained, the use of EMIS systems is often limited to a financial software package,

financial procedures are designed for full-time fee collection and not able to cope with part time students. Institutions need help to develop the operational characteristics that support capacity planning and administration of flexible and blended delivery approaches.

Lack of qualified teachers

TVET has long had a perceived image problem (CINTERFOR, 2009; CEDEFOP, 2011) and is seen by both prospective teachers and learners – as a less attractive alternative to higher education. Learners prefer to attend higher education institutions if they can gain a place, and technically qualified technicians can earn a better living working in industry than in TVET teaching. Educators in developing countries report a widely held perception that TVET leads only to low-status occupations and prevents access to higher levels of education. Learners who enrol in TVET are considered to be those who have failed in general education, in the sense that they did not obtain entry to higher education. There is, therefore, a contradiction between the generally negative public image of TVET and the strategic role it is supposed to play in economic and social development.

In developing countries, particularly in Africa, the Pacific and some Caribbean countries, TVET teachers tend to have lower levels of technical and vocational qualifications and often no pedagogic training. Coupled with this is a lack of industry experience or industrial practice acquired many years previously. Stevens, in the 2001 World Bank study of distance education for TVET in Africa, pointed out that "*Distance education is believed by many to hold promise in addressing critical problems facing skills development at present, namely: a lack of qualified instructors, the need to greatly increase the delivery of skills training on a wide scale, and the need to deliver training at much lower unit costs owing to constraints on financing."*

Countries moving towards ICT in TVET tend to focus first on the upgrading of teachers' ICT skills, both basic skills and the pedagogic skill-sets needed to integrate ICT into teaching and learning. Distance TVET teacher training is a feature in African countries such as Zambia and Botswana through low-tech methods using print-based materials. GeSCI calls for lecturer competencies to be redefined to efficiently include ICT and pedagogic development in Africa. They have developed a set of TVET ICT teacher competencies based on the UNESCO Teacher ICT competencies (GeSCI 2011).

The introduction of technology and media-enhanced teaching approaches may assist in making TVET not only more accessible but also more attractive. Physical access to the latest equipment may not be possible in a developing country context but exposure through educational media may help to mitigate this disadvantage. The lack of qualified TVET teachers can, in part, also be mitigated by the use of open education resources such as for laboratory and workshop simulations which have been developed by experts. The Remote Web-based Science Laboratory from BCampus is a good example http://rwsl.nic.bc.ca/

Demand for flexible, continuing skills training

The demands of a knowledge economy require continuous re-skilling of the workforce to keep up with changing technology. Australian VET operates in a competitive market geared to industry and employer needs, and provides for the re-skilling of the work force. As 90% of VET learners are part time, at the inception of the Flexible Learning Framework there was a need to better target training to the needs of working learners. This included high quality training delivered in an open manner, with flexible hours,

content, and location of the training for the learners. The use of ICTs created unique opportunities for flexible delivery (location and timing of lessons) as well as learning content that could be adapted and reused to target particular learner audiences. eLearning was perceived as beneficial for both students and training providers.

The most important aspect of elearning is the flexibility it offers institutions to develop new access paths to meet the needs of learners. As vocational training and re-training becomes increasingly important in providing lifelong learning opportunities for working people in the developed world, elearning offers the most flexible option in terms of time, place and pace of study. As the 2011 Horizon Report on global emerging technology, explains, *"People expect to be able to work, learn, and study whenever and wherever they want."*

> "When asked to describe the benefits of e-learning the responses overwhelmingly focus on issues of flexibility, choice, convenience, timing and being able to balance home, life and work with their study commitments."
>
> Flexible Learning Framework, 2011

There is a clear link between these drivers. The development of knowledge economies is influenced by the rapid developments in technology which also mean there are increased demands for ICT skills training and upgrading in the workplace. Coupled with governments' and development partners' successes in meeting the MDG and EFA goals of universal primary education, the 'secondary surge' of students demanding access to technical and vocational education will continue to increase. But TVET is already suffering from a lack of qualified teachers and conventional teacher training methods cannot hope to supply the number of qualified teachers required. Finally, the increase in ICT in the workplace requires employees and would-be employees to continuously upgrade their skills to meet the demands of a knowledge economy. ICT is being employed in TVET systems in flexible and blended approaches to meet the needs of these drivers.

3. How is ICT used in TVET?

International agencies such as UNESCO-UNEVOC use ICTs to facilitate networking between TVET practitioners and policy makers through online forums www.unevoc.unesco.org/eforum.php and content repositories such as TVETipedia www.TVETipedia.org. COL supports an online Community Learning Network which forms of community of practice for African TVET practitioners and there are numerous local online communities such as the BCampus SCoPE (Social Community of Practice in Education) platform – http://scope.bccampus.ca. Through such online resources, TVET educators, managers and policy makers can share information and expertise to strengthen individual and institutional competence and work collaboratively on the development of projects and open educational resources.

Educational media and technology is being used in a variety of ways in response to the drivers identified in Section 2. We have identified four key uses of ICT in TVET:

- Flexible and blended learning
- Curriculum integration
- Assessment
- Meeting special learning needs

Flexible and blended learning

These two, very generalised terms, are widely used in the discourse about ICT in education. The potential of ICT to create a more responsive, individualised curriculum in support of lifelong learning has attracted much policy attention. *Flexible* learning

broadly describes the ways in which this idea might be operationalised, while *blended* learning describes the integration of new modalities and approaches with traditional teaching methods. Together, they represent significant change to traditional TVET institutional culture. The use of ICT delivery mechanisms questions the need for the common structure of two or three years, full-time, institutional-based initial TVET programmes, often for inefficient class sizes. The traditional format does not address the calls for more convenient delivery patterns for a range of target groups, including disadvantaged youth who need to combine skills training with earning a living.

Hampton & Bartram propose that flexible approaches to delivering learning must be an integral part of the educational infrastructure, not an optional extra. Not only does this approach require different strategies for implementation and the deployment of significantly different policies and practices across entire systems and within TVET organisations, it requires different relationships with the learners. (Hampton & Bartram 2002).

It is important that technology is used appropriately. The rapid spread of mobile phones with internet access and low cost computers, has opened up large possibilities of personalised, virtual learning. These have already been taken advantage of by open universities systems world-wide. These new ICT applications can supplement both the theoretical and practical aspects of many TVET competencies. The commercial educational publications sector has been quick to take advantage of this with many book publishers now offering supplementary interactive materials on their websites. A market has even grown for online training in traditional VET skills area such as plumbing and electrical installation. www.train4tradeskills.co.uk are claiming they have 30 virtual reality environments where skills can be acquired.

Brazil has a long history of distance learning in VET and this has developed into a focus on elearning using a range of teaching materials including digital videos, animations and simulations, web pages, audio materials, print materials or digital multimedia. Communication tools are also a feature such as email, telephone, fax, letters, FAQs, online forums, chat, videoconferencing, web conferencing and virtual learning environment are used to enable the access to classrooms and content and to favour interaction with tutors, monitors and lecturers as well as among students. Learners access a combination of learning resources and computer-based interaction particularly adapted to their needs. (CINTERFOR 2010).

Research conducted by the Institute for Prospective Technological Studies (IPTS) show that the increasing uptake of social media in everyday life provides new opportunities for innovation in education and training institutions and represents an opportunity to prepare the learners of the 21st century (Ala-Mutka et.al. 2009). In the UK, research has demonstrated the benefits of Web 2.0 tools in educational management, student learning and engagement, library function and resource provision and academic social networking (JISC, 2010).

> "Increased worker autonomy, participative decision making, technology, and knowledge work have led to a need for workers who not only specific occupational skills, but also a range of generalised workplace skills such as problem solving, decision making, critical thinking, communication, and teamwork that increasingly are part of being up to date."
>
> Wonnacott 2001

Curriculum Integration

People are most employable when they have a good standard of secondary education as well as employability skills including teamwork, problem solving, ICT, language and communication skills (UNESCO 2002). ICT is increasingly being included in the set

of employability skills known variously as key skills (Botswana), core skills (Scotland) or catalytic skills (World Bank). The generalisation of these skills is not easily defined for ICT within the fast-paced changing world of technology. Currently, generic productivity software and the use of communication tools e.g. email and the Internet, are commonly specified as the learning outcomes. These learning outcomes are relatively easy to prescribe and appropriate assessment instruments easily defined. Every TVET student is then supposed to learn and be assessed for this new set of generic ICT literacy skills. This approach supposes that those who enter TVET have little or no skills learned elsewhere eg at school or through the use of mobile technology. It also implies the use of traditional applications, running on a local PC and takes no account of the recent emergence of Web 2.0 services or 'cloud' technologies. This is illustrative of the difficulty faced by TVET institutions; how to keep the curriculum up to date, integrate ICT, while the technology options broaden and change the notion of what a generic skill might be. Neither policy nor practice can keep up to date with the pace of change. In addition, there are occupation-specific ICT skill-sets which learners need to acquire. Engineers and designers need to program CNC equipment and draw using CAD/CAM tools. Accountants need to use financial software.

The UK mlearning project, MoLeNet, as one of four focal areas, investigated the value of mobile technologies for key skills learning. They noted that key skills is often the least popular aspects of VET courses for learners. However, they found that mobile technologies encouraged participation and learners' engagement with key skills subjects increased which resulted in improved retention and improved achievement (Douch et. al. 2010).

ELearning is used in different ways: to support teaching and learning which takes place in institutions, as well as for blended learning which combines distance learning with face-to-face learning at the institution. A study of elearning in initial VET in EU countries (EU 2005) describes how elearning is used in 4 specific ways:

1. For communication between learners and their teachers, tutors, mentors or master craftsmen or among a group of peers using both synchronous (chat, SMS) and asynchronous (threaded discussions, blogs) technologies.
2. To simulate real-world phenomena; ICT, through 3-D simulations can provide opportunities for students to simulate practice when real-life practice in not possible or affordable.
3. As a learning resource, elearning provides opportunities for learners to engage with interactive elearning units and rich media sources, using speech, video or interactive sequences or instructions.
4. Learning management systems (LMS) enable elearning content to be made available to students in a structured and accessible form. They manage, track and report on interactions between learners and content, learners and learners and learners and teachers.

e-Assessment

e-Assessment is emerging as a major driver for elearning for both students and staff. It is increasingly being seen as providing a partial solution to providing assessment for increasing numbers of students and declining staff to student ratios. Some of the benefits of e-assessment include immediate feedback to students, provision for rehearsal and revision, immediate feedback to staff, facilitates evaluation of a course's strengths and weaknesses and provides links to other computer−based or online materials. e-Assessment also has the other advantages of remote access and choice of

time and place of assessment. Security and authenticity are issues which can be addressed by limiting the location of the assessment or through supervision.

Research into e-assessment has been carried out by the UK digital technology in education agency, JISC. They report that at Loughborough College, a paper-free assessment system was introduced in 2009 which enabled all activities associated with the assessment of assignments – submission, plagiarism checking, marking, moderation and verification – to take place online. Subject tutors initially found it challenging to mark assignments and give feedback online, but both tutors and students came to appreciate the greater consistency of marking and easier access to feedback that the online system introduced (JISC 2010). The 2005 European study showed that IT is increasingly being used for student assessment, especially among the front-runner countries. However, it is clear that this remains an area to be further developed in most institutions.

Meeting special learning needs

There are enduring inequalities in the provision of TVET the world over: urban dwellers access TVSD more than rural dwellers; boys more than girls; those with higher levels of basic education more than those with lower levels; and of course, the able bodied more than those with special needs. Other groups are also disadvantaged - such as street kids, young people who are the victims of war, refugees and displaced persons and all those who have special learning needs.

> "If the general picture is grim, it is even grimmer for girls."
> UNESCO UNEVOC 2006

The most important educational resource to provide for those with special educational needs is trained teachers but these are usually in short supply. Edwards et. al. (2001) indicate that, *"When human resources are inadequate, it is often easier to procure and provide technological solutions and it is most fortunate that in special education, technology can play a highly beneficial role. Although economic restrictions can affect access to technology, it can represent a good investment."* The delivery of vocational education and training using ICT has the potential to increase access of learners with a disability. (ANTA 2000:4)

Access to training for increasingly important sections of the workforce remains limited in many European countries, despite being the target of various training measures for some time. Women, older workers and people with disabilities are targeted in EU policy with member states being encouraged to integrate these groups more fully into education and training (Bainbridge et. al. 2003). In the same report, EU policy noted that lack of opportunities for open and distance learning is a weakness of European education and training systems. In Jordan, the e-TVET strategy specifically targets increased access to TVET for women.

The ILO describes equal access to vocational education and workplace learning as a fundamental principle of cohesive societies. They recommend a 'life-cycle' approach to overcoming the challenges confronting women in gaining access to VET. Logistic, economic and cultural barriers to apprenticeship and VET need to be overcome by taking into account women's home and care responsibilities. "*Flexible and blended approaches to VET, through the use of technology-enhanced programmes can assist in this regard"* (ILO 2010:28).

Adaptive and assistive technologies

Because ICT is pervading the world of work and increasingly, the world of education and training, those who cannot use computers because of physical or learning difficulties will increasingly be left behind in terms of educational opportunities and job skills and employability. For example, audio content is invisible to search engines. To mitigate such problems, there is a range of adaptive and assistive technologies used not only in TVET but generally in special needs education. The World Wide Web Consortium (W3C) defines assistive technology as "*Software or hardware that had been specifically designed to assist people with disabilities in carrying our daily activities."* Adaptive technologies aid by adapting content or user responses from one form to another. (ANTA 2005:3)

To assist the visually impaired, technologies include screen readers and voice synthesisers, braille systems, optical character recognition systems and text enlargement software. To assist those with physical challenges, keyboard and mouse alternatives are available such as trackballs, foot mouse and mouth joystick. Those with hearing difficulties can access telephones through teletypewriters or text-telephones.

UNESCO warns that although ICT has the potential to improve enormously people's access to quality education and training there is a "*danger that these technologies may create a "digital divide" and worsen existing inequalities in education and training between urban and rural areas, between rich and poor, between those who possess and those who lack literacy and numeracy skills and between developed and developing countries."* (UNESCO 2002:61). This is a potential danger but there is increasing evidence that ICTs can contribute to resolving equality issues in the provision of technical and vocational skills development. This issue, as ever, is one of political focus and funding.

4. Success factors and challenges

During the last decade the use of ICT in TVET has increased in both developed and developing nations. In countries where ICT in TVET has matured, such as Australia, recent reports indicate the positive impact on learner outcomes. The Australian 2011 eLearning benchmarking Survey reported that 55% of students said elearning helps them to do their current job better and 42% said it helped them to get a better job. What lessons have been learned by the front runners, or early adopters, that will assist those countries still embarking on this path? Can the lessons learned in developed nations be applied to developing countries and how are these solutions being contextualised to suit developing country contexts?

Success Factors

Four main success factors are identified in the effective integration of ICT in TVET:

- Enabling national policy
- Commitment of institutional managers
- Champion support for elearning
- Recognition of the changing role of the teacher

Enabling national policy

Countries which have made the most progress with integrating ICT into technical and vocational training are those with the strongest national policy supported by funding resources and national programmes. These countries include Australia, South Korea and many of the European Union countries. It is interesting to note that developing countries are also creating enabling national policy frameworks for ICT in education

generally (Rwanda, Kenya, Guyana, Ghana) but also specifically for ICT-enabled distance and flexible learning policies for TVET, such as Jordan, Botswana and Zambia.

It is interesting that 'bottom-up' approaches are gaining some traction in developing countries as institutions use their existing resource to demonstrate that the quality of TVET teaching can be improved through ICT and flexible and blended approaches. If we follow Fullan's educational policy advice that 'you can't mandate what matters' then it could be said that the change to technology-enhanced approaches is best negotiated and starts with the early adopters (Fullan 1973). There is evidence that policy makers soon take notice when change starts to happen and resources can be found for local solutions which are responding to national policy challenges.

Commitment of managers

Practitioners and agencies report the critical success factor of commitment and leadership from institutional heads (EU, 2005; CINTERFOR, 2008; COL 2011). Without strong leadership which ensures inclusion of strategic objectives in planning processes, creates appropriate organisational structures, supports the strengthening of ICT infrastructure and focuses on staff capacity building, ICT initiatives cannot succeed.

In their study of the role of technical cooperation in the integration of ICT in TVET Latin American countries, CINTERFOR states: *It is obvious that the new ICT have made it possible for the knowledge developed in VTIs to be disseminated more quickly and more easily, but this effort has also been given a considerable boost by the active interest shown by directors and heads of programmes..* (CINTERFOR 2008:15).

Champion support for elearning

One of the organisational structures that institutional heads or even national frameworks use to good effect are elearning *Champions*. These are usually early adopters of the technology and new teaching paradigms who have developed new pedagogic skills and assist and support colleagues. Often they are unpaid for these additional tasks but act out of a belief and personal interest in the new teaching and learning methodologies. From 2000 – 2004, the Australian Flexible Learning Leaders programme identified potential leaders in technology, pedagogy, and innovation in a position to influence change within their own institution and at a state level. The achievements of elearning in TVET in Australia are due, in part, to their successful efforts.

Ten TVET institutions in Africa who are working collaboratively to introduce flexible and blended approaches to programme delivery through the Commonwealth of Learning Flexible Skills Development initiative have all appointed Champion Teams to promote and support the uptake of new ICT-enhanced approaches. The institutions that are making the most progress have the most active Champion teams.

Changing role of the TVET teacher

There is little doubt that the new technologies and teaching approaches bring a change in the role of the TVET teacher from instructor to facilitator. UNESCO in their study of 21st Century Skills warn developing countries that there is a need to develop ICT-appropriate methods of teaching rather than simply adding computers to existing teaching methods (UNESCO 2002). The current EU-funded project – SVEA – which is looking at the use of Web 2.0 technologies in TVET in five European countries has

> "The increased use of ICT into TVET has resulted in a major paradigm shift from a total dependence on the objectivist paradigm to a growing adherence to the constructivist paradigm."
>
> Chinien 2003.

identified the change in the role of the trainer to what they call a 'moderator'. Institutions which recognise and support this changing role of the TVET teacher find a smoother path to change than those who continue to support more traditional pedagogic methods of teaching and learning.

Challenges

While there is evidence of distinct country successes, it is clear that the process of change of ICT integration must take a long term view. In the developed world, even with a strong commitment to infrastructure and staff development, it has taken time to develop policy that is sufficiently flexible to adapt to new technology innovations with the potential to influence learning and teaching. The different structural models of TVET do not appear to have influenced ICT uptake. This is perhaps due to the establishment and expansion of new ICT support agencies or new roles within existing curriculum or the provision of sector-wide development support. The institutions have also found it necessary to create new roles, even new departments, to support institutional progress.

The situation in many developing countries, particularly Africa, is less promising. While national policy at the ministry level is developing, it is often framed in achieving quantitative objectives such as student:computer ratios. There may be some central support capacity for introducing ICT, but this is mostly directed to schools with little or no attention paid to TVET. The institutions are mostly left to develop their own strategies to address national policy in a situation where they have poor, although improving infrastructure, low levels of ICT skills amongst teaching staff, and no institutional experience of how to respond to technical, pedagogical, cultural, and social change. In Zambia, where the level of government subvention to TVET institutions is very low (less than 6% in some cases) it is cost-prohibitive for institutions to progress the use of ICT. The costs have to be passed on as increased fees to learners which then reduces the number of the population who can afford TVET courses. Even when support agencies have been established, it can be difficult to make the impact that is expected. A survey of ICT trends in education in the Caribbean (Gaible, 2008) concluded that regional support agencies had yet to significantly impact on delivery of education by tertiary learning institutions. Some institutions attempt their own ICT skills upgrading, but this is often based upon the available hardware and software resources and a national ICT curriculum which is not fit for purpose.

The dangers of the digital divide

We can identify the potential for two types of digital divide; we have already considered that the use of ICT may cause further disparity in access to TVET between urban and rural dwellers or affluent and poorer students. There is also a potential for the use of ICT in TVET to widen the gap between countries which can provide affordable bandwidth and ICT infrastructure and facilities and those who cannot. Despite the recent proliferation of sub-sea fibre links along both the west and east coasts of the African continent, consumers still pay considerably more for bandwidth than those in in Europe, Asia and North America. Twinomugisha (2010) suggests it is 50-100 times more; Jensen (2006) states it is 'thousands of times higher'. Prices for Internet access have decreased – but only by a factor of 2 rather than 10 as expected. Reasons for this are complex but some African countries (Namibia, Botswana) suffer from monopoly or duopoly situations and operators in West and East Africa blame the high costs of fiber infrastructure and situations of high-demand, low supply. The slow speed of competitive national backbone roll out is cited as an issue by Jensen (2006).

One of the biggest challenges facing government Ministries and institutions is how to fund the technical infrastructure and provide the technical support functions required for ICT integration. This is particularly true where TVET has suffered from years of neglect and lack of funding to upgrade existing technical infrastructure. In many African institutions ICT upgrading is being undertaken in a phased approach which starts with expanding the use of existing available technology and develops incrementally as new approaches become embedded in teaching practice. Even in the face of high costs (and poor electricity supply) there is evidence that TVET institutions are finding ways to afford Internet services because of belief in the potential of the technology (Mead Richardson 2011). There is evidence that with a coordinated and focused approach which involves Ministries, institutions, students and development partners in a phased manner, appropriate technology can be made available. Of course, this should take place within a context of similarly focused staff development and adapted organisational structures.

> "The issue of buying personal laptops is very practical, we have tried it in our Institute and it is working miracles. Initially we thought our Principal was punishing us when he said each member of the FaB team must have a laptop. No financial support was given but in two weeks' time 90% had laptops. The projector which was initially kept in the store now has a high demand. We have wireless internet spots in the compound and this has also motivated us."
>
> TVET Lecturer Kenya

5. Future trends

Whilst this is a retrospective of the developments of ICT integration in TVET over the past decade, it is worth considering the emerging trends that are already in evidence. Technology is, by its very nature, dynamic and innovative. There are many developments which may, or may not, turn out to be important in technical and vocational education. Here, we have chosen two which we believe are already important and whose significance will grow in the short term future. They are the adaptation and use of open education resources and the use of mobile devices like smart phones and tablets.

Mobile devices

Mobiles phones have become ubiquitous in both developed and developing nations although the relative costs of airtime for voice, SMS and data are still widely disparate with developing nations often paying far more for airtime. But the widespread reach of mobile phones into even the most remote areas is attracting increasing attention from

educationalists including for TVET. Whilst simple voice and SMS phones are the norm in most developing countries, GeSCI points to research which estimates that 69% of mobile phones in Africa will have internet access by 2014 due to early adoption of technology by young people and increasingly affordable mobile services.

Mobile learning is particularly attractive to the TVET age group in initial training and evidence is starting to appear which demonstrates that it is effective. The UK MoLeNet project research found that the use of mobile technologies in work-based and vocational learning contexts can result in increased learner engagement and improved retention and achievement in technical and vocational training. The Commonwealth of Learning mobile learning initiative for agriculture training, empowerment and entrepreneurship has demonstrated that capacity building using ICTs such as mobile phones and networking can improve livelihoods and empowerment among subsistence farmers. To date, 20,000 learners in Asia and 4,000 in Africa are involved in self-directed learning through ICTs. Due to better credit management by farmers and due to the increase in the volume of mobile phone usage, banks and mobile phone companies are recognizing the potential of this approach as a viable business strategy.

The annual Horizon report from EDUCAUSE identifies emerging technologies likely to have a significant impact over the coming five years around the globe. The 2011 Horizon Report examined emerging technologies for their potential impact on, and use in, teaching and learning. They indicate the trend that more institutions are finding ways to take advantage of a technology that nearly all students and staff carry – the mobile phone (Johnson et. al. 2011). Horizon also indicates ebooks as increasing in importance in higher education but it is also believed that the more versatile and potentially powerful tablet and 'pad' PCs will become viable in TVET in the medium term future – in both developed and developing countries.

Open Education Resources (OERs)

One of the most important educational movements which is starting to impact on TVET, and is facilitated by the use of ICT, is the availability and use of open education resources. OERs can greatly facilitate teachers' development of new flexible learning approaches in skills education and training. TVET teachers embarking on more flexible delivery approaches can access existing content and contextualise it to their own curriculum, thus speeding up the process of materials development. Where teachers lack technical expertise in specific aspects of a vocational subject, expert materials can help to bridge the gap. Copious use of OER content repositories such as Connexions (cnx.org) and Khan Academy (www.khanacademy.org) is being made by TVET teachers all over Africa. Physics simulations such as those found on PhET (phet.collorado.edu) can provide learners with access to laboratory experiments when no laboratory is available. There are few OER content repositories specifically focused on technical and vocational subject areas. This is likely to change in the future as development partners and other agencies turn their attention towards OERs for TVET. USAID has recently embarked on a project through Asia-Pacific Economic Co-operation (APEC) to raise awareness about the educational possibilities of OER in TVET and aims to stimulate greater sharing and use of OER across the Asia-Pacific region.

The National Learning Network project in the UK has recently placed online more than two thousand *learning objects*, many of which were developed specifically for TVET subjects. They can be viewed online and be downloaded, although the licensing conditions for own use is unclear. The Australian government funded the development of the Flexible Learning Toolboxes and the Learning Object Repository Network. The

network was developed to enable learning resources to be shared and reused across the Australian training system, but it was closed in 2011. In Canada, since 2003, BCcampus has leveraged CAD9 million in Provincial education funds for post-secondary institutions to develop technical and vocational OERs. Countries where elearning in TVET is a recognised policy priority have government focus, and funds, to progress this important initiative. These materials are available to all post-secondary institutions within the jurisdiction but unfortunately, in both cases, the majority of the education resources are not *freely* available outside the country (in the case of the Australian toolboxes) or outside the Province (in the case of British Colombia). TVET development would benefit if the OER movement, which is gaining traction in higher education, were to turn its attention to technical and vocational education and assist in bringing such resources to a truly open forum. The acceptance and use of OERs still has some way to go in TVET but they are likely to prove meaningful in this sector as they have in basic and higher education.

6. Conclusion

In 2000, UNESCO and the international community set the ambitious goal '*to ensure that the learning needs of all young people and adults are met through equitable access to appropriate learning and life skills programmes'*. Whilst we might wish that much stronger statements regarding technical and vocational skills development had been made at the turn of the century, the evidence presented in this chapter indicates that ICTs can and are being used in TVET to make access and quality gains, albeit within a stated objective of transitioning to a notional knowledge economy. Both developed and developing nations are making policy statements and to a greater or lesser degree funding the development of content and infrastructure for increasing use of ICT in TVET.

The analytical lenses proposed by UNESCO reflect the policy and public expectations of TVET so it is useful to evaluate the use of ICT in TVET through these lenses. Flexible approaches to skills development, using appropriate technology can contribute to the provision of more training opportunities, improve the quality of provision and possibly, in the longer term, reduce costs. However, this requires a combined effort between government policy makers, institutions and possible partnerships with information and communications technology providers. This includes new organisational structures, new qualifications structures, and ways of describing and assessing skills. In addition, competency based approaches, modular and credit based systems and flexible management and leadership of both physical and human resources are required. To date, there are very few comparative cost studies which help us understand how the cost structure of TVET is affected by new technologies and approaches. This is a critical area which the TVET research agenda could address but to date there is no evidence, even from countries with mature elearning systems that ICT contributes to improved efficiency in TVET.

The potential to enable more and different learners to access TVET is being realised in developed nations like Australia, Korea and Europe and could have the same impact in developing countries where demand far outstrips supply, if the funding focus follows the political rhetoric. There are clear cases of ICT integration contributing to the ability of TVET to meet the changing demands of emerging industries. This can also serve as a way to make TVET responsive to the needs of learners and employers requiring more flexible course offerings in terms of time, place and pace of study.

By facilitating greater access to learners who have previously been locked out of the TVET system ICT can contribute to more equitable access to TVET. Working adults could have increased opportunity to study technical and vocational programmes online. Through assistive and adaptive technologies the potential is there to improve access for the physically challenged. However, the concept of economies of scale, coupled with the inability to provide basic technical and vocational training equipment, mean that most governments are some way from making provision of these technologies a priority and there will be continued focus on non-governmental organisations to provide for this group. There are other disadvantaged groups who might benefit from an overall increase in access to TVET which the use of ICT in flexible and blended approaches could contribute to – but they will need to be specifically targeted.

The relative attractiveness of TVET and its qualifications as a journey for learners, can never match the societal esteem which is placed on the preferred academic routes. The *parity of esteem* debate is an unnecessary and unwelcome distraction and can be used to justify underfunding and the isolation of the TVET sector. The relevancy of TVET lays not in comparisons with other forms of education, but in the role it can play in improving the livelihoods of those, the large majority of citizens, for whom an academic qualification is unreachable. The esteem of TVET lies, not in the eyes of the academic minority, but in the eyes of those to whom it represents a second chance. If TVET can, through the application of ICTs, begin the transformation to become an agent for a more equitable knowledgeable society, through such devices as qualifications frameworks that support articulation through and across all levels of tertiary education, then it may also begin to acquire the political influence it needs to persuade governments to rectify the *disparity of funding* from which it suffers. Only then, will TVET be able to reach the levels of quality, effectiveness and efficiency that others aspire for it to achieve.

ICT provides opportunities for teachers to use innovative delivery approaches by integration into technical and vocational subject content. But innovation is not well supported within traditional hierarchical management systems. The traditional role of TVET as a provider of workers with relevant skills to a local formal economy, is now challenged by the new requirement to satisfy the needs of a global economy. Skills are important for innovation, but arguably, if we want to create more economic and social innovation, then it must be encouraged and experienced while skills are being developed. The lesson from the developed nations is that the hegemony of traditional teaching approaches will not easily be challenged even when the ICT infrastructure improves.

ICT will increasingly be supportive of the lifelong learning paradigm which fits well with the needs of a developed economy, providing workers of all ages with the opportunity to retrain as industries relocate and transition between technologies. In developing countries, the rationale for lifelong learning through formal TVET systems would appear to be invalid, since many institutions cannot cope with the demand from schools leavers, let alone returning adults, and the industrial base remains heavily dependent upon natural resources. However, lifelong learning has been successfully implemented in many countries and could provide both a strategic and operational model for developing countries in the sense of an implementation framework for the kind of flexible, responsive institution that many policy drivers now suggest is required. The lifelong learning agenda should be harnessed by TVET in developing countries as the way to both model their institutional operations and support the transformation to strategies supportive of an *equitable learning agenda.*

We have seen how some developed nations have mature models of ICT in TVET, particularly Australia, South Korea and countries in Europe. But many developing nations, in South America, Africa and elsewhere, are also exploring the potential of ICT for more flexible and blended approaches and curriculum integration for the primary purpose of increasing access. The main drivers of ICT in TVET emanate from attempts to meet the demand of maturing or emerging knowledge economies which includes keeping pace with ICT and new technologies in the workplace. All of this points to new pedagogical approaches; behaviourism is making way for constructivism and connectivism.

Success factors are emerging and can be identified from both mature and emerging TVET elearning systems. Policy and funding support is obvious although there is evidence of 'bottom-up' approaches gaining traction. However, it cannot be expected that many senior managers of institutions are knowledgeable about ICT or its promise and potential. It is therefore important that capacity building in technology leadership, emphasizes the importance of management sponsorship and mentoring of the early adopters and local change *champions*. Clearly, teachers' roles are changing and this is challenging in an educational sub-sector which is already vulnerable through a lack of qualified teachers. The cost of infrastructure and technical capacity to support it will always be a challenge but there is evidence that ICT integration can take place through local initiatives.

The integration of ICT in education in developed nations, has introduced a policy, pedagogical and structural paradigm change agenda that has permeated to many developing nations creating a complexity of challenges that can be overwhelming. The promise and potential of ICT to increase access to TVET and improve the quality of education generally, is being realised to some extent, but progress is slow.

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Annex A Working Definitions

Researchers in ICT in TVET have commented on the lack of a definitional base for some of the new terms in use (Brennan et al 2001). Here we present definitions found on the websites of national and intergovernmental agencies.

Blended learning
Learning methods that combine e-learning with other forms of flexible learning and more traditional forms of learning such as face to face classes.
Australian Flexible Learning Network
www.flexiblelearning.net.au/aboutus/jargonbuster.htm

Elearning
The delivery of content via electronic media, such as the internet, video, interactive TV and CD-ROM. E-learning encompasses all learning undertaken, whether formal or informal, through electronic delivery.
UK Higher Education Funding Council www.hefce.ac.uk/aboutus/glossary/glossary.htm

Life Long Learning
Lifelong learning encompasses learning at all ages and subsumes formal, non-formal and informal learning.
UNESCO Institute for Lifelong Learning http://uil.unesco.org/home/programme-areas/lifelong-learning/

mlearning or mobile learning
The exploitation of ubiquitous handheld technologies, together with wireless and mobile phone networks, to facilitate, support, enhance and extend the reach of teaching and learning. Mobile technologies can include mobile phones, smartphones (including iPhones), PDAs, MP3/ MP4 players (e.g. iPods), handheld games devices (i.e. Sony PSP, Nintendo DS), small digital cameras and headcams, Ultra Mobile PCs (UMPCs), mini notebooks or netbooks, handheld GPS, voting devices and specialist handheld technologies used in science laboratories, engineering workshops or for environmental or agricultural study. Mobile Learning Network (MoLeNet) 2010 www.lsnlearning.org.uk

Educational media
Includes text, audio, video and elearning. Educational technology or ICT refers to communications equipment used to deliver media and includes print, DVD, radio, television, SMS, mobile phones and computer networks. www.col.org

Vocational education and training (VET)
VET is post-compulsory education and training which provides people with occupational or work-related knowledge and skills.
Australian Flexible Learning Network
www.flexiblelearning.net.au/aboutus/jargonbuster.htm

Knowledge Economy
An economy where knowledge is the main engine of economic growth. In World Bank terms it encompasses elements or pillars such as education and training, innovation and technological adoption, the information infrastructure, and a conducive economic incentive and institutional regime.
World Bank siteresources.worldbank.org/KFDLP/Resources/KAM_Paper_WP.pdf