

1-1-2010

Technology Transfer and Human Resource Constraints and Challenges: A note to the developing world

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Recommended Citation

Dartey-Baah, Kwasi (2010) "Technology Transfer and Human Resource Constraints and Challenges: A note to the developing world," *Academic Leadership: The Online Journal*: Vol. 8: Iss. 1, Article 32.

DOI: 10.58809/RFBT6325

Available at: <https://scholars.fhsu.edu/alj/vol8/iss1/32>

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Academic Leadership Journal

Introduction

Three decades ago, international multinational firms' approach to technology transfer was by licensing technologies to host nations or local markets which often involved high costs. Nations who bore the brunt of these were developing countries. Even so, most were unable to afford the full use of the technologies and therefore had to make do with downgraded versions.

Looking back 30 years, conditions have changed and most developing countries are technologically capable and sophisticated. Although countries like Brazil, China and India have made significant strides, most African countries have fallen behind in this journey. The good thing is, with globalisation and free trade; certain technologies previously controlled by certain developed countries are finding their way into the developing world markets without the associated costs. For example, some multinationals now invest in developing countries in order to obtain a base for export to other sub-regions and by doing so make available aspects of their technologies. The opportunity developing countries have is to create an environment which would attract multinationals to invest into their countries without compromising the freedom of their people. This approach will enable developing countries to gain insights into emerging technologies, while taking the opportunity to develop their own technologies. It is for this reason that the right human resource capabilities with the appropriate skills are essential.

The challenges and constraints developing countries face must therefore give way to this thinking if they are to make use of the opportunities that the globalised world offers. Additionally, the globalisation of the world has also meant that it has become easier for developing nations to enter into partnership and joint ventures with global firms. This arrangement offers opportunities for the much needed skills and technology transfer to take place at a level not possible 30 years ago.

On the issue of partnership in particular, what developing nations bring to the table is important. Any form of partnership must not compromise local and national aspirations. Where there are difficulties, high level negotiations for a win – win situation must be the aim. It is also important for developing nations to work with the developed world as partners. The challenge is having the right human resource capabilities equipped to understand international business operations. This therefore calls for the exposure of their people to the developed world's work approach and thinking.

At this point, it is worth stressing that without a trained and equipped people with the stamina to grasp the workings of technologies, learning and skills acquisition, this aspiration could at best be a mirage. In all this, technology transfer will only flourish when there is synergy between the knowledge disseminator and receiver, a full appreciation of the differences and similarities that may exist between the environment giving and environment receiving; and where compatibility between ideas and information dissemination strategies are recognised.

What is Technology Transfer?

Technology transfer is the process of sharing skills, knowledge, technologies, methods of manufacturing and facilities among governments and other institutions to ensure that scientific and technological developments are accessible to a wider range of users. Technology transfer does not end at the first level of sharing the existing knowledge but there should be a determination to go further with the shared skills and knowledge through developing new products, applications and services. In ancient times, [Archimedes](#) was noted for applying science to practical problems. This is the call of technocrats and hence the need for the right human resource capabilities.

The “Environmental” Factors

One of the important elements key of technology transfer is the environment within which this takes place. Naturally, a technology developed for a particular environment may not be suitable for another and where adaptation is the way forward an acknowledgement of this prior to the transfer process would be instrumental in dealing with teething problems which otherwise would occur. Though, it may sound simplistic clearly establishing the differences between the environment giving and receiving in terms of their differences, similarities and compatibility is crucial. Since human resources play an important role in the transfer of technology, having personnel who have adequate training and appreciation of the “environmental” factors (differences, similarities and compatibility) on both sides of the arrangement cannot be overemphasised.

The Processes

Fundamentally, at the pinnacle of technology transfer is the flow of human knowledge through exposure to developed markets, education and direct human contact. The role of human resources can be grouped into several processes; knowledge creation, organisational approaches, role of the user, role of the deliverer of the technology and the existence of an advocate for the technology transfer.

The role of human resources is crucial because it is central to both the development of the transfer technology and the application of the same. For developing nations to participate in the international technological economy, possessing a broad range of scientific and technological skills would be essential. Undeniably, some inventions have been made by individuals with little education but in today’s world, marked achievements and inventions are made by people with substantial education in science and technology. The application here is, without investments and commitments to human resource development and in the universities in particular, developing nations will continue to struggle to produce human resources capable of comprehending the workings of technology transfer. To rise above the constraints and challenges, a number of issues would have to be addressed and prominent amongst these are:

- (a) Partnering with the developed world on technological education
- (b) Regional Cooperation
- (c) Special Reward Arrangements
- (d) Visa Acquisition Matters
- (e) Funding Education and Research

(f) Socio-political Matters

(g) Improving Organisational Structures

Partnership with the developed world on technological education

Building stronger links with the technologically advanced countries working on projects together would be one of the ways to acquiring skills and developing a capable workforce to address the constraints and challenges developing nations face. Partnership with the developed countries should be entered into, bearing in mind that it's not only about what they can get from their partners but also what they can offer. This means working on programmes which are relevant to both sides.

In addition, clear policy development between governments and industries for an arrangement where students from the developing world can work as interns on high profile schemes with partners of the developed world to acquire skills would be beneficial (Seguin, Singer and Daar, 2006). For example, some Indian and Taiwanese graduates having had the opportunity to participate in Silicon Valley firms in the United States acquired valuable and transferable skills and went back to start their own firms bringing employment to the local people. These countries benefit at lower costs, with much-needed revenue generation as a result.

Finding answers to the questions below would be useful in the pursuance of this approach:

- (i) How are potential candidates going to be selected/ catered for?
- (ii) What are the perceived benefits and how can this be quantified?
- (iii) How can it be ensured that such candidates do not take up employment in their host countries but return to share acquired knowledge?
- (iv) How should a situation where people refuse to return to help after their training be managed?
- (v) How often should progress be monitored and reviewed?
- (vi) How soon can this process begin?

The recent financial downturn worldwide highlights one very important fact and the application to this discussion is the fact that gone were the days when individualistic approach to governance prevailed. We now live in a world where none can live in isolation. Eventually, the cost of underdevelopment in the developing world would be shared by all including the developed world. As such no stone should be left unturned in helping each other develop and acquire skills that would benefit all of us in a global economy. The challenges of skills transfer is a global one and therefore demands a global response.

Regional Cooperation

In addressing the human resource constraints and challenges it is no secret that the nature of the challenges training institutions in most developing countries face are such that in many instances, they will not be able to build their resource capacity alone without cooperation with other regional partners. The benefits of regional cooperation can be through information sharing, resource sharing and

resource mobilisation (Massaquoi, 2002).

Most universities in the region would have developed policies and strategies to overcome some of the human resource problems and it would be useful to share experiences. Sharing experiences would deal with repeating mistakes that others have made and prevent “re-inventing the wheel” scenarios. Conferences and meetings could be mediums for sharing information and learning from one another. To carry things through, setting up working groups to follow up and review strategies can be essential in dealing with the problems. As the world becomes smaller and smaller through information technology, it will be unfortunate if developing countries do not strengthen the bond between them and work together for their common good. Much as the developing world need the support of developed partners it is also important that they harness and maximise the bond that comes naturally through their similar backgrounds and build on the unwavering friendships and support that exist amongst them.

Nations in the regions may be weak individually but collectively can be strong by mutually helping each other. With a determination to beat the resource constraints, with cooperation and team work, strong institutions can work with weak ones. Some institutions may have good laboratories and facilities but poor resource capabilities and vice versa. Through cooperation such challenges can be addressed. Working together to set up high level training courses within the region could also address the problem of brain drain which has played a significant part in the resource constraints and challenges. For a balanced discussion, it is worth adding that a number of professionals will travel abroad to learn and acquire useful skills for the development of their nations, but with the right policies such professionals will return to their home countries to help build their nations. As developing nations work together the guiding principle as in any human endeavour and practice is the respect for the rule of law in respective countries.

Special Reward Arrangements

In order, to encourage relevant nations to participate in the initiative to assist in technology transfer, governments of developing nations could investigate the creation of a special scheme where international governments who show willingness to helping developing nations develop their human resources get priority during project bidding and awarding of some types of contracts (Privilege Group). This could encourage more countries to sign up to the idea and increase the chances of strong partnership between developing and developed countries.

Local consultants who also show unparallel commitment to people development through Career Progression Development (CPD) initiatives should be rewarded in contract allocations or qualify to bid for some type of projects. This will call for local consultants to submit themselves to thorough monitoring, an exercise and arrangement in which the skills of professional institutions in the respective counties would be needed. Transparency and the commitment to enhance knowledge acquisition and transfer and human resource development should be the motivation in all these initiatives.

Visa Acquisition Matters

Some constraints often faced by students seeking to study abroad have been with visas. Many would agree that the exposure to alternative ways of thinking and analysis is important in the technology transfer journey. Lots of progress has been made with regards to student visas acquisition but there are still opportunities for improvements. Studying abroad may not be the way forward for everyone but

those who go that route could play an important part in skills transfer. Measures should be put in place to allow students visa appeal processes to be swift where visas have been refused. This means reaching an agreement on deadlines for visa decisions. Whilst it is appreciated that there is the need to ensure that the right people are given entry into their chosen countries, the delays often experienced during appeals do not appear to take into account the impact these delays have on students. Clearly, it is not enough to ask for the necessary assistance to be given to students in terms of visa acquisition but to also ensure that there is a monitoring system in place to ensure that those who go on the ticket to study do so and are also encouraged to return to help their respective countries.

Funding Education and Research

In funding educational ventures, the challenge for most developing countries lies with the trade off between elementary and secondary schools improvements. Whilst improving advanced education (secondary education) is crucial for technology transfer, what is important is not a trade off between the two since one cannot exist without the other but rather greater commitment from governments to ensure that both levels of schooling are given the needed attention. Having the appropriate levels of capable resources does not only depend on the capabilities of the training institutions but also on the availability of potential students to enrol and acquire the needed skills. This highlights the fact that any constraints on developing elementary and secondary education to the appropriate levels and enrolling the right numbers, will impact on professional training. In tackling the human resource challenges, a broad and balanced strategy is required which looks at what can be achieved now and in the future. That is why a complete separation between elementary schools, secondary schools and professional schools may impact the latter from finding enough potential trainers for the future.

Investment in education and training are crucial components for the development of human resources and this has to be an integral part of strategies developed to tackle these challenges. It is worth stressing that dealing with the constraints on human resources for example in the engineering sector doesn't only involve the relevant engineering ministries but also the ministry of education. Unless there is a strong partnership between these ministries and with the allocation of high priority to the development of human resources any additional investment in training would risk being unproductive. The challenges and constraint on human resources due to poor education is immense and therefore any programme or efforts geared towards improving it will be worthwhile and extremely valuable and significant to skills acquisition and transfer.

In the USA, overall the government universities and non-profit institutions fund roughly \$95 billion of research and industries fund \$181 billion (US, National Science Foundation, 2004). This is 34% public and 66% private. In most developing nations, the balance is more weighted in favour of the public sector. For Brazil and India the public sector proportions are much higher approximately 59% for Brazil and 77% for India (UNESCO Statistics in Barton 2007). The public sector involvement in funding research is very important to developing capable human resources and producing a competent workforce capable to take on new challenges and this must be continued. Public sector involvement is often more of building infrastructure than creating new world industries. Further, public sector involvement in funding and providing support could be to "jump start" initiatives. The governments of developing nations must see the role they play in research as important to capacity development and therefore must commit more resources to research and also create a favourable environment for businesses to support.

Businesses in developing nations invest less in research compared to their developed counterparts. There may be a number of factors why this is so. It could be that developing nations are technology followers rather than initiators. This approach may be appropriate in the short term but in a fast moving world of technology, for the developing nations to take their place in the global market, investment in research will be important. In all this, without the right human resource capabilities with the best equipments and funding, the research output will be poor.

To get the full benefits of research there should be a stronger collaboration between academia and industries. It is particularly important for industries to know researches being carried out, technologies being developed and to work together from the laboratory to the market place.

Socio-political Matters

The social political economic situation of a country influences retention of human resources and development of the same. Good governance and the overall policy framework, political stability, security, accountability influence professional practice. Until the recent financial downturn worldwide, there has been a continuous demand for engineering professionals in high income countries in specific fields and therefore without the right socio-political climate, developing nations risk losing their scarce human resources exacerbating the challenges of technology transfer.

For Ghana, in 1990's it was estimated that 50% of locally trained doctors were living and practising outside the country mainly in high income countries like UK and US (Dovlo and Nyongator, 1999).

In dealing with the constraints and challenges developing countries face in terms of human resource, until the pull factors of immigration to high income countries and the push factors in low income countries are simultaneously addressed, investments in developing resource capabilities are likely to be in vain (Wyss, 2004). To succeed from all the efforts being put into developing a capable workforce able to adapt and develop new technologies, a well balanced and elaborate national retention policy and strategy will be required.

Improving Organisational Structures

Improving an organisation's performance is important in dealing with human resource constraints and challenges. Staff commitment and dedication to work are determined by a number of organisational and management factors. After acquiring all the technical knowledge and enhanced research capabilities, if the right management strategies are not put in place there will be challenges with the expected outcomes.

Creating the right work environment in organisations positively affects staff commitment, motivation and performance. A good work environment, which is supportive of their staff, is believed to produce satisfied and motivated workers. Environments where bullying and domineering tendencies thrive affect staff commitment and motivation. Handy (in Nelson and Quick, 2005) argues that 'an inspired work place will result in inspired workers'.

For developing countries to develop their human resource capabilities to match that of the developed world and importantly capable to play a part in technology transfer, leadership must show commitment to effective management practices. For example implementing effective performance monitoring

systems would address productivity issues and produce a workforce capable to comprehend and contribute to technology development and skills acquisition (Hornby and Perera, 2002). In addition a well defined career path and progression linked to salary levels will motivate and help draw the best out of a workforce, which is what is needed in improving and acquiring new skills.

Further, addressing the resource challenges that developing nations face, calls for the review of the current state of their capabilities and a strategic vision of future requirements. Leaders must know where they want to be and guide their staff to that destination. Without a clear vision of the future from leadership and an aspiration for their staff's development with a strategy to achieve these objectives, no significant progress can be made.

In practice, organisations match their strategies to their goals (Huczynski and Buchanan, 1991). For example, managers are faced with the dilemma of how to satisfy and motivate their staff, which motivational theories to employ to suit their individual employees at the same time as ensuring that organisational policies and boundaries are not over stepped. On the other hand employees also expect organisations to satisfy their needs or expectations for which they have joined that particular organisation. Daft (2003) states that there is a psychological contract that exists between employees and their organisations and that different groups within an organisation have different goals. It therefore requires leadership to clearly identify the needs within their organisations and as much as possible ensure some level of coherence between functions within the organisation and staff goals.

Furthermore, to make the best use of people or an organisation's employees requires the integration of good human relation practices into the process of management. This will ensure that both workers and management expectations are not compromised. Job satisfaction is also one of the functions of management essential to ensuring total commitment to an organisation. Total commitment of staff is important to developing a motivated staff ready to learn new skills and be innovative.

Concluding thoughts

This paper has looked into issues that play important roles in addressing the resource constraints and challenges developing nations face with regards to technology transfer. It has highlighted that either in the adaptation of technology or the creation and development of the same, competent and capable human resources are central to their realisation.

It has been discussed in this paper that the constraints and challenges that confronts the processes of technology transfer are multifaceted with human resources development at the centre of the debate. These include the weakness of the available human and material resources for the tasks not because developing nations are not capable but because of lack of financial resources, investments, non-committal to effective management principles and lack of strategic all encompassing policies.

This paper suggests that regional cooperation, partnerships with the developed world, investments in education and research with collaboration between academia and industries, visa acquisition matters, coordinated policies and strategies backed by effective management strategies at the heart of organisations have a role to play in addressing and confronting these challenges and constraints.

Additionally the following actions should be taken to enhance and develop capable human resources fit for purpose and ready at all times to take on and develop new technologies:

- Develop a data base of available human resources outside the country in agreed relevant areas with the view to maximising the use of their acquired knowledge to aid in skills and technology transfer;
- Develop a database on available human resources in the sub-region on research in science and technology to ensure optimum use of available manpower in the region;
- Provide more funding for knowledge acquisition and studies abroad whilst putting in place structures to ensure the return of these professionals;
- Encourage regional cooperation in the share of information, resources and resource mobilisation;
- Encourage stronger collaboration between elementary schools, secondary schools and professional institutions whilst encouraging stronger cooperation between industries and academia.
- Stronger partnerships to be developed between science and technology ministries and the ministries of education;
- Identify the pull factors to high income countries and the push factors from developing nations and developed a national retention policy;
- Establish a forum that encourage exchange of experiences and ideas;
- Organisations to invest in their staff and show commitment to their development.

[This article was modified from a presentation at the Ghana Institution of Engineers Annual Conference in Accra, March 2009]

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VN:R_U [1.9.11_1134]