INFORMATION TECHNOLOGY PRODUCTIVITY PARADOX

T Mogotlwane, Prof F. Khosrowshahi, Dr. J. Underwood
Research Institute of the Built & Human Environment, University of Salford,
Greater Manchester, M5 4WT
E-mail: t.m.mogotlwane@pgr.salford.ac.uk

ABSTRACT: The paper looks at the development of the Information Technology Productivity paradox by examining the viability of IT investment and its impact on productivity. The work in this area will be critically examined in order to establish the patterns associated with IT investments and their impact on productivity and investigate the sources of productivity paradox. The paper will also reveal the main issues that are considered as the source of the conflicting views within the research community in this area. The work in this paper is part of a broader research project, the aim of which is to develop an operational framework regarding impact of information technology on productivity. The resulting framework is intended for exploitation by the developing countries by learning the experience of developed countries. Particular reference will be made to Botswana where information and communication technology infrastructures are fairly developed.

Keywords – Developing countries, Information Technology Investment, Information Technology, productivity paradox.

Key:
IT – information technology
ICT - information and communications technology
EPR - enterprise resource planning
ITS - integrated tertiary software
EFQM - European Foundation for Quality Management

1. INTRODUCTION

There has been a lot of debate regarding the impact of IT investments on productivity. The majority of literature indicates that there has not been any conclusive result in proofing or disproving whether IT investments leads to productivity gains. Interest in the impact of computers in organisation increased significantly in the 1980’s. (Brynjolfsson and Erik, 1998) are among the researchers who did a lot of work in the subject. However, research did not lead to conclusive results on the economic value of IT. The debate and research was propelled further after the Nobel Prize economist Robert Solow summarised the problem by stating that “We see the computer age everywhere except in the productivity statistics” in the New York Times Book review in July 1987. Solow’s statement received wide coverage in the media. Ives (1994) called IT professional to understand issues relating to productivity paradox so that knowledgeable contribution can be made to the issue. This lack of consensus has been referred to as information technology productivity paradox (Oz, 2005).

This paper forms part of a broader research project, which looks into the impact of ICT application in performance of government departments of Botswana. The focus of the paper is a critical evaluation of literature on the issues about the information productivity paradox. A global view of literature is taken and this will form the basis for determining the appropriate conceptual model that can be used in Botswana. The literature review has shown results of research that has been done in western countries. There is very little work on the impact of IT in developing countries. However, developing countries have also invested in IT. Countries like
Botswana have IT budget currently at 3.7% of the total budget (Table 1). Previous research was done before the internet exponential growth. The internet, which is one of IT applications, has revolutionised the world through e-commerce, e-learning etc. These concepts were not developed during the era of intense debate about IT productivity paradox. There is a need to do further research to see if the IT paradox still exists as it was claimed about ten years ago.

2. METHODOLOGY FOR THE INVESTIGATION

The methodology that has been used for the investigation consists of quantitative and qualitative approaches to literature review. The quantitative approach, referred to as “abstracting”, was used to get a quick overview of current and previous research on the topic. The abstract review process is a method of quickly getting feel of a paper under review without reading it completely. Under this process, the paper is located using the normal search tools available, and then copies of abstract and conclusions of paper are made. The reviewer then read through the abstract and conclusions and summarises the paper and the conclusions that have been made. The main aim of this method was to get an overview of the different schools of thought on the information technology paradox and determine the main issues and pattern emerging. The qualitative approach is the next phase of the research and is not covered in this paper. The following sections discuss findings of the abstract review discussed above.

3 CRITICAL EVALUATION OF LITERATURE

The literature has revealed a number of research results, which try to explain why there is the information technology productivity paradox. Several approaches were taken by previous researchers to study the problem, for example. (Black and Lynch, 2001) looked at work practices and IT, (Jing et al., 2003) applied economic model of duopoly and (Peslak, 2003) used financial and market based measures. In trying to get a holistic view of conclusions from the literature, the following broad areas appear to be the most frequent. The following sections discuss findings of the abstract review process.

3.1 Measurement Errors

The problem of measurement errors in determining the impact of IT has been identified by a number of authors (Mahmood and Mann, 1993) indicated the problem of measuring IT impact due to the fact that there are other factors that contribute to an organisation’s performance. [(Anderson and Rust, 1997), (Brynjolfsson, 1993) and (Hitt and Brynjolfsson, 1996) etc., are some of the authors who have also linked the problems of determining IT impact to what is measured. This is because of other factors that come into play in organisations such as infrastructure, assets etc. Also it is difficult to isolate the impact of other factors and attribute output to IT only. A closer observation reveals that research published in the early 1990’s tend to highlight the problem of measurement often. This is the period when IT was mainly being used to automate manual processes and the communication capabilities were still at an early stage. (Strassman, 1997) also indicated problem with measurement and how they
were used to calculate productivity improvements. Strassmann was looking at the work of (Brynjolfsson and Hitt, 1996) when they thought they have disproved the IT paradox.

3.2 Adaptation Strategy

The strategic adaptation of IT in organisation was also reported to be a contributing factor. This emerged from research work covering the end of the 1990’s. The argument was to link IT strategy with business strategy so that IT becomes a supportive tool to business not a burden. This emerged after the automation era of the early 1990’s when organisations created numerous islands of automation that were difficult to communicate with one another. [(Sugumaran and Arogyaswamy, 2003), (Schrage, 1997) etc] brought to the discussion the fact that it was the strategy that organisations use that influences the impact of IT. Gates, (1999) summarised this by stating, “…unfortunately computers will only help business that adjust its daily operations to take advantage of the computer”. This problem still exists today. Organisations are still not using the computer to its maximum capacity to support their business. (Carr, 2003) support this by stating that “studies of corporate IT spending consistently show that greater expenditure rarely translate into superior financial results. In fact, the opposite is usually true”.

3.3 Effective Use

Another issue in dealing with the impact of information technology that emerged from literature is that of effective use. Here effective use means the ability of an organisation to use the power of information technology to its maximum. (Sircar et al., 2000) argued that being able to use computers effectively was more important compared to the amount of money being spent on them. The improvement in hardware performance and software capabilities has been faster than the adaptation of IT to business environment. This has lead to IT pushing organisation to invest rather than organisation discovering that there is a need to invest. Under utilisation of IT is also a factor (Carr, 2003). This is evident from the popularity of using word processors more than any other office application programmes such as spreadsheet or database. This might be due to the legacy of typewriters, which were used for a long period of time. Also the major activities in most organisations are mainly dealing with text-based documents. However, despite under utilisation, there is a need to meet costs associated with upgrade and licensing fees of programmes including those under utilised. The problem of lack of effective use has also been reported by (Davenport, 1997) who stated that “But information—or at least the effective use of it—has not improved at the same rate as technology spending”. This state of affairs cannot be allowed to continue if mankind is to reap the rewards from ICT capabilities.

3.4 Type of Business

Impact of IT has also been linked to the type of business where it is being used for example, in research by (Quan et al., 2004) it was found that, IT investments impact on firm’s performance depended on market sensitivity to changes in the competitor’s
price and quality of service. (Stratopoulos and Dehning, 2000) pointed that the positive impact of IT does not last long as it is easy for IT to be implemented by competitors when they realise positive results from their business rivals who have invested in it. The secret seems to be -invest in IT and use it effectively to gain market share before your rival gets in. Carr (2003) stated, “… the window for gaining advantage from infrastructure technology is open only briefly” to emphasise the point of responding quickly to demands in the market place. Dearlove (1999) has identified that among the ten secrets of Microsoft Success, “Be in the right place at the right time“ was number one.

3.5 Positive Impact

From around 2000 onwards, research reports showing positive impact began to emerge e.g. work of (Chowdhury, 2003) showed impressive results of IT investment in the banking industry. This research was done in developing countries of the Asia and Pacific Basin region. This might be an indication that IT applications were beginning to show maturity after the initial implementation and adaptation phase of the 1990’s. Hence companies, which have position themselves appropriately in terms of use of IT, were beginning to get the rewards. (Devaraj and Kohli, 2000) reported positive impact in the health care industry. Another issue that emerged was that positive impacts take time [(Dewan and Kraemer, 1998), (Brynjolfsson, 1998), etc]. The main problem that face organisations is that IT calls for continuous investments through upgrade of both hardware and software; hence any positive impact gained is overtaken by the cost of upgrade.

Although previous research in the productivity paradox were inconclusive, most of the research reports were mainly on business and technology. The issue of people has not received thorough research coverage.

4. ICT IN BOTSWANA

Botswana despite being a developing country has a fairly developed ICT infrastructure. This has been acknowledged by other external agencies for example, UK Development of International Development chose Botswana when it sponsored research on ICT and Small Enterprise in Africa. According to Duncombe and Heeks, (2001) Botswana was chosen due to “its relatively well-developed ICT infrastructure, and its favourable policy environment”. Moore, (2000) wrote, “Botswana has a greater degree of digitalisation than Japan”, acknowledging Botswana’s advances in ICT. Botswana has invested significant financial resources in ICT as shown in Table 1.

<table>
<thead>
<tr>
<th>NDP No.</th>
<th>Duration</th>
<th>Amount in Pula (P)</th>
<th>% of Government Budget</th>
</tr>
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<tr>
<td>7</td>
<td>1989-1996</td>
<td>19.3M</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>1996-2003</td>
<td>600M</td>
<td>2.7</td>
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<tr>
<td>9</td>
<td>2003-2010</td>
<td>1.3BN</td>
<td>3.7</td>
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4.1 ICT Applications and Productivity in Public Sector

There is a need for Botswana to aim to utilise ICT to the benefit of the nation. One of the areas where ICT may play a role is in service delivery. Politicians, public as well as the business community, have accused government departments of performing to below expectation. While government red tape bureaucracy may also be a contributing factor, ICT has the potential to open up government resources to its nation. (Venson, 1986) looked at lack of productivity in civil service in her MSc thesis. This shows that concern for improved performance in civil service is older than introduction of IT in central government. Of late even ICT has been blamed for contributing to the problem (Maine, 2005).

It can be argued that concern of lack of productivity has always been there; hence it is not appropriate to link ICT to it. This is a fair comment, however ICT has potential to contribute to improvement of productivity. Unfortunately the implementation of ICT in central government was rapid due to external pressure among the few who were IT literate at the time and did not follow a systematic approach; there was no ICT policy at the time. A policy is the best guiding document for any government. IT is only now that the policy is being discussed through the Maitlamo project.

4.2 ICT Applications and Need for Change

Government of Botswana has been commended for commitment to ICT development (Moore, 2000). Unfortunately the culture of most government departments is still dominated by the old non-computing era. Hence ICT implementation was tied to old business processes rooted in people’s minds, which may not be able to sustain the culture of information era. Faraj (2005) highlight this point by stating, “Users must give up old ways of doing their job, whether manual or automated, and adjust to accomplishing the same tasks with the new system”. What is needed now is to transform employee’s attitude towards work, so that they can be able to utilise IT to serve. It may be the case that, ICT in Botswana is being utilised to a large extent for data storage. The problem is in retrieving that information from databases or data store to meet different needs. The following three cases illustrate this point.

4.3 Information Technology Acquisition in Botswana

A lot of ICT system in Botswana are bought from outside. The country does not have an industrial base to produce things like hardware. However for application software, which is application specific, the country still import such products. At the beginning the problem was due to the fact that there were very few qualified citizen in the field of software development, i.e. programmers. Through a massive training campaign, the government provided funding for locals who have successfully completed higher secondary education as well as serving officers to go for further training in ICT related programmes. There was even an establishment of computer science department in the local university (University of Botswana) to develop ICT skills locally as it was too expensive to train them outside e.g. in UK, USA etc. (Maitlamo, 2004) has called for further research to determine whether ICT goods and services
products are based in Botswana or outside. This research will contribute to this request for more work in the area.

There is now abundant human resource trained in the areas of ICT, unfortunately their expertise is not being put to use when software applications are developed outside the country. The philosophy of software acquisition in Botswana needs to be re-examined so that the appropriate approach is taken to empower citizens. It is the intention of this research to also determine the financial implications of all the systems that have been bought from outside. (Maitlamo, 2004) also reported that company executives were not willing to assign implementation of complex IT applications to locals. This might be because such companies are foreign based and are not willing to invest their resources within the country.

The other problem with imported ICT systems is that due to commercial reasons, the supplier may not make source code & test data of such systems available. However such information might be useful for maintenance at a later stage. Botswana is not alone in buying off the shelf systems; many organisations resorted to comprehensive packages called enterprise resource planning (EPR) which emerged in the mid 1990's. There was hope that EPR will reduce costs associated with system development and maintenance in house (Faraj, 2005). EPR have a lot of functionality for an organisation e.g. Integrated Tertiary Software (ITS) of South Africa provides almost all functions performed by an academic institutions e.g. financial, administrative, academic etc. As EPR has a lot of functionality they cost a lot more. Hence if they are under utilized, this will be a loss to an organisation.

4.4 Declining Revenue for Government

Lately the country has been facing a lot of challenges e.g. persistent draught, HIV/AIDS etc that are all calling for financial intervention. These challenges have tremendously reduced government revenue for example the budget allocation for fighting HIV/AIDS is almost more than that of some ministries. It is for these declining financial resources that government must look at some of the possible ways to reduce cost of foreign services and systems like in ICT. Government HIV/AIDS intervention accounted for 85% of budget of Ministry of State President budget of P1.11 billion (Gaolathe, 2005). This figure is more than twice the budget for the army.

5 THE BROADER RESEARCH PROJECT

Recent concern raised by various institutions in Botswana about the problem of lack of productivity in central government e.g. (Ibrahim, 2005) as well as the steps taken by government to provide the appropriate ICT infrastructure to support service delivery has prompted this research. (Maine, 2005) associated ICT with poor performance. These have prompted for a thorough investigation to find what could be missing in ICT implementation and use.

The argument for this research is presented in Figure 1. This is based on Taulmin’s structure of a research argument.
The next stage of literature review will be using the qualitative approach, now that the various schools of thoughts have been put into perspective. It is now moving from abstract review to critical literature review where a paper will be analysed and evaluated in order to get a scholarly view of its message. The epistemological approach, which forms the basis of the research, is the constructionism approach. This is because the topic under research is looking at how people interact with technology in order to gain understanding of their attitudes that may lead to low performance. It does not fall on the objectivesim or subjectivism, as this problem is more of social science than pure science. The philosophical position is phenomenology. Figure 2 illustrates the research approach.

A case study method will be used to gain further understanding of the research problem. Case study method is chosen, as the researcher does not have any direct influence on the subject or environment under study. There will be a pilot study in UK to test the method before it is finally used to collect data in Botswana.
6. FURTHER AREAS FOR RESEARCH

In order to understand the impact of ICT in organisations, there is a need to do further work on people issues, both as users and recipients of services offered through ICT. This will form a very important contribution, as it is ultimately the people that use the technology and are to be served by the technology.

6.1 People Issues

Literature review has not yet been concluded; the issue of people in organisation (employees) needs to be further researched. Employees are the one who use ICT and they have a role to play in understanding the IT productivity paradox. There is the question of how users are supposed to adapt to the new environment. Often it looks like users are expected to just get on with ICT and do the job. This might be true especially for large IT systems, which is bought of the shelves as compared to small in-house, IT development.

IT systems are developed using system analysis and design methodology. (Tudor and Tudor, 1997) stated three objectives of systems development all of which try to capture the business environment as best as possible. This approach tries to capture as much as possible the business environments so that the system will support current and expected future needs. It therefore follows that if the methodology is used to develop in-house IT systems; the true business environment is likely to be captured. The main problem with off the shelf systems is that they are based on a model which may not necessarily conform to the organisation’s working model, hence the organisation has to adapt its business strategy to IT instead of the other way round.

6.2 Human Issues in ICT

Employees of organisations are human beings and hence people have individual way of communication as well as emotional behaviour, which cannot be ignored in the business environment. Embedded human beings qualities are hard to be incorporated into any computer programme. System development methodologies have not yet been able to capture the enter-personal communications and emotional intelligence of human beings. This is why experts system did not deliver up to what was expected out of them, the reason being that psychology of human being will always remain with a person and it changes unpredictably. (Davenport, 1997) also argues that where information changes too fast to maintain, this will make it difficult for expert systems to generate useful knowledge. Davenport (1997) stressed the importance of people by stating that, “information and knowledge are quintessentially human creations, and we will never be good at managing them unless we give people a primary role”. An area that has been under researched in determining the impact of ICT is that of people. This is the area, which will be covered by this research. Unfortunately people cannot be controlled by a computer programme hence human communication and attitudes must be incorporated in studying the problem of IT productivity paradox.

Alter (1996) identify only three types of people namely, participants, users and IT professionals. (Underwood, 2005) showed that an information system is made up of three interacting components namely information technology, processes and people
all participating in and environment as shown in Figure. This shows that people are fundamental to ICT success. This research will bring in the fourth group of people namely customers. These are people who are to be served by ICT applications. They are also the people who bring value to an organisation as their satisfaction about service can determine the rise or fall of any business.

![Fig. 3. Interaction of IT, People, Process and the Environment adapted from (Underwood, 2005)](image)

The role of people in ICT evaluation has also been noted in European Foundation for Quality Management, 2001 (EFQM). In the EFQM excellence model people are identified as one of the five enablers to attain results. The other enablers are leadership, policy and strategy, processes and partnership & resources.

For Botswana, the IT side is established, the processes are in place and the environment is ideal. This has been acknowledged by external academics e.g. the ICT’s and Small Enterprises in Africa project, which was funded by British Overseas Development Agency (Duncombe and Heeks, 2001).

7. CONCLUSIONS

This paper has demonstrated that the information technology paradox discussions were mainly in the 1980’s and 1990’s. However it has not had any influence on companies reducing their IT budget. On the contrary IT budget continue to grow. The productivity paradox research was intense in the 1980’s through to the end of the 1990’s. This was before the internet revolution swept across the globe. There is need to do further research to see the type of impact the internet era has had towards the problem of information technology paradox. This is especially true for developed world where internet is heavily used to provide services to the communities. May be the information technology paradox has been reduced now. However for Botswana, the information technology paradox is still there, as shown by recent literature in Botswana.

The problem of lack of exploitation of ICT in Botswana appears to be linked to people using the technology. It is the intention of this research to investigate this problem further. A pilot study will be conducted in the UK. The pilot study is
intended to investigate ICT utilisation and its impact. The results of this study will contribute to understanding latest developments regarding the information technology productivity paradox. It will also test the case study research method before it is used in Botswana for the main research. In Botswana, the research will cover government departments. By nature government agencies are not in business to make profit, but to provide better service to the people at minimal costs. These will be the focus of the research in Botswana.

8. REFERENCES


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