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# Encouraging Pilot Projects before Large Scale Deployment of ICTs in Ghanaian Polytechnics

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**Abstract**— This paper outlines and stresses the importance of encouraging and embarking on pilot projects before large scale deployment of Information and Communication Technologies (ICTs) in the educational sector of Ghana, specifically in Polytechnics. Through a review of relevant literature, the paper targets and focuses on how Polytechnics in Ghana can plan and execute piloting procedures of ICT projects before large scale deployment. Furthermore, using a proposed system-wide approach, the paper provides a guide on how Polytechnics in Ghana can interpret information from ICT pilot project experiences to aid decision making processes (whether to execute large scale deployment or not) and plan procedures for effective deployment of large scale ICTs.

**Index Terms**— ICT Projects, Large Scale Deployment, Pilot, Project Management, Polytechnics and Ghana

## I. INTRODUCTION

IN the past few years, ICT for development initiatives have proliferated and the resources devoted to ICT in development portfolios have expanded in the hope that ICT can help developing countries reach the Millennium Development Goals (MDGs) [1]. Nevertheless, rigorous field-tested knowledge about “what works and why” in ICT for development, and a thorough understanding of the enabling conditions and successful factors in ICT for Development initiatives have been quiet scarce [1].

The Republic of Ghana’s ICT for Accelerated Development (ICT4AD) policy document was enacted by parliament in the year 2003 [2]. Through this policy, the Ministry of Education (MoE) in Ghana is increasingly deploying ICT solutions and projects to various educational institutions (basic, senior high and tertiary) at both regional and district levels. However, without the help of individual educational institutions, MoEs worldwide generally have little experience or difficulty in deploying technology nationwide and also ensuring such tasks are executed successfully [3].

Under the MoE in Ghana, there are ten (10) public

Polytechnics, namely: Accra, Bolgatanga, Cape Coast, Ho, Koforidua, Kumasi, Tamale, Takoradi, Tamale and Wa Polytechnics [4]. These Polytechnics are currently using ICT to improve their education (practically-oriented) in various activities such as effective teaching and learning as well as access to reliable information about them to the general public [4].

Large scale ICT projects require careful analysis and planning and sometimes include one or more “pilot” deployments [3]. Pilots are generally described as learning tools that are considered and analyzed before large scale deployment. It is therefore important that educational establishments such as Polytechnics in Ghana consider piloting their ICT projects before large scale deployment. As noted by the Global e-Schools and Communities Initiative (GeSCI) [3], most pilots are considered as the first phase of progressive deployment and not as an opportunity to improve and learn the design of the programme. This paper notes the assertion by [3] and further outlines and stresses the importance of encouraging and embarking on pilot projects before large scale deployment of ICTs with a focus on Polytechnics in Ghana. Additionally, the paper provides a guide on how Polytechnic in Ghana can interpret information gathered from ICT pilot project experiences. In terms of ICT deployment on a large scale, such procedures will enhance decision making and planning processes (whether to execute ICT pilot projects or not) by Polytechnics in Ghana.

The rest of the paper is organized as follows. Section II presents a Literature Review, Section III presents ICT Pilot Projects in Ghanaian Polytechnics and Section IV presents a Research Discussion. The paper is finally concluded with a recommendation in Section V.

## II. LITERATURE REVIEW

This section of the paper reviews relevant and existing literature pertaining to the subject matter. Initially, the paper reviews ICT Project Management, then the procedures involved in Piloting of ICT Projects and finally strategic plans that have to be considered in ICT Pilot Projects. The review stresses the importance of ICT Pilot Projects and shows the relevance of ICT Project Management in an educational establishment.

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### A. ICT Project Management

In a developing country such as Ghana, many companies/organizations including Polytechnics rely on Information and Communication Technology (ICT) to provide accurate, relevant and timely information. ICTs are constantly implemented, upgraded, modified or replaced to obtain and sustain a competitive advantage. These initiatives are often managed as projects [5]. While financial resources and effort being spent on ICTs are increasing, these projects are not always perceived as successful. It is therefore important to understand the factors that influence the outcome of ICT projects in organizations relative to their original constraints [5].

The failure of large and complex ICT projects has gained the attention of politicians and public managers. Decision-makers/management of organizations are looking for procedures to reduce the number of project failures. It is therefore important to verify architectures that alleviate project management risks in order to reduce ICT project failures. Enterprise Architecture (EA) has been signaled as a way to advance digital government developments. This has resulted in the development of building blocks, principles, standards, models and other architectural instruments [6].

With the Standish Group's CHAOS Report [7] proclaiming ICT project success on a mere one-third of projects, project managers have a global responsibility to gain control of the situation. Through concrete scope management processes, ICT project managers can learn and embrace proven approaches that measure the size of software projects, streamline the requirements articulation and management and impose solid change management controls to keep projects on time and on budget [8].

In comparison to other projects, ICT projects are unique. This is because ICT projects are characterized by emergency, short term and uncertainty. To implement an ICT project successfully, problems in the particular ICT project must be found, analyzed and solved. ICT project managers play a key role in both implementing and controlling stages of ICT projects. The project managers should regard ICT project management, as a system, deal with various relationships and the parties concerned in the system well and conduct management innovation [5], [6], [9].

Through the usage of adequate communication channels, ICT project managers should communicate with all the stakeholders, i.e. the components of the system, including the client, the management, and the team members to know their requirements, needs and problems respectively. When this is done, ICT project managers can provide satisfactory responsiveness clients, get support from the management, lead and control the team outstandingly, and make the team work efficiently [9].

### B. Piloting ICT Projects in Educational Institutions

The term 'Piloting' of an ICT project is defined as the implementation of ICTs, that include both hardware and software, or related projects on a small controlled scale to

allow for its full impact, benefits and weaknesses to be evaluated before implementation on a large scale (institutional, regional or nationwide basis) [3].

For example, before equipping all Polytechnics in a Ghana with computer laboratories, a few of the Polytechnic computer laboratories can be configured and tested. The testing can measure their performance over a limited period of time. This enables stakeholders and specialists/consultants to learn from the experience and refine the requirements for a larger scale deployment. Alternatively, before deploying a new ICT curricula supported by educational software for a Polytechnic such as MATLAB, the software tools can be installed in a few computers in some classrooms/laboratories to test how the students and lecturers interact with it and react to it. This will introduce opinions as to whether the pilot software is good and standard enough for both students and lecturers in order to enhance effective teaching and learning in Polytechnics.

In some countries around the world, Ministries of Education in conjunction with tertiary institutions and high schools are currently running pilot projects to test [1], [3]:

- *Software Implementations:* Open-source operating systems such a Linux, educational tools such as Moodle, digital classroom environments using Liquid Crystal Display (LCD) projectors, multimedia development tools (i.e., images and audio created by students) and programming tools for software development.
- *New Educational ICT-Supported Applications:* For example cameras and multimedia used in classrooms, one-computer-per-student (1:1) models like One Laptop per Child (OLPC), distance learning/education and e-learning, educational and community telecenters, Internet access for curricula support and creative collaborative content development (e.g., wikis and blogs).
- *Hardware Implementations:* For example thin vs. thick clients, computer labs in education institutions of different levels, computers in classrooms of various educational institutions, alternative electrical sources like solar and wind and communication servers.

Piloting of an ICT project involves the setting-up of a desired technical environment (hardware, software, content, training, furniture, support material, etc.) in a "controlled" space where its performance can be measured, tested and evaluated. Piloting of an ICT project enables a selected group/team of intended users to interact with the technical environment and find potential problems for onward recommendations and solutions [1], [3].

For ICT pilot projects to contribute to mainstream development in education there is a need for evidence based interpretation from a forward looking perspective [1]. In order to fulfill the needs of infoDev [1], its donors and partners, emphasized that ICT pilot projects should be viewed as applied research. Therefore, ICT pilot projects need to address specific hypotheses and generate appropriate data. For this to happen there should be a common approach. In order to meet these requirement infoDev [1] proposed a framework which focused on gathering the evidence required, so that an

evidence based interpretation or judgment of the potential outcome of mainstreaming an ICT pilot project in development activities and taking it to scale can be achieved.

In Bangladesh, the education curriculum has been modernized to meet international standards. For various reasons, qualified teachers are not keen to move to rural areas. The same is true in areas of health sectors where qualified medical doctors are not willing to move to rural areas [10]. A pilot project to test the potentials of e-Learning was implemented at a village Nohata in Magura district in Bangladesh<sup>1</sup>. Started in 2006, the e-Learning project has been using ICT tools to communicate, learn, and access international quality educational content. International teachers/lecturers of high repute and quality standards have been conducting teaching using a videoconference system [10]. Various relevant e-Learning aids have been developed to meet the local needs and conditions, YouTube<sup>2</sup> programmes covering different topics are carefully selected to meet the appropriate requirement of different target groups. The links are downloaded so that the students and teachers can follow the links as many times as they want and discuss among themselves [10].

Foskolos *et al.* [11] focused on the implementation of two pilot projects for the introduction of ICT in Greek schools. These projects (introduction of IWB and COWs) were supposed to be the first steps of the implementation of “digital schools” which is the government’s strategy for ICT adoption in education. The authors in [11] discussed key findings of the two ICT pilot projects and suggested ways in which the ICT pilot projects could be improved.

The Ministry of Education in Sri Lanka embarked on piloting a One Laptop per Child (OLPC) project in selected primary schools in the country [12]. In this context, Rahuman *et al.* [12] selected a remote school participating in the project in Badulla district to ascertain whether the OLPC pilot project was existent and feasible. ICT enabled teaching and learning is a very new concept for teaching children and also requires the need to adjust to new learning styles of children. The authors in [12] therefore studied the adaptability to ICT enabled education environments. They used a mixed research methodology approach consisting of quantitative and qualitative to gather data by questionnaire and interviewing of teachers, children and parents of the school. Firstly, questioning teachers led to the second step of discussing and observing children and to the third step of speaking with parents. The results obtained using their method showed that activities using OLPC increases innovation and creativity of children in drawing, audio recording and video capturing compared to traditional existing primary school pedagogy based on books. Furthermore, the ICT pilot project in [12] helped students and teachers to share knowledge and explore required learning beyond the curriculum.

One cannot determine beforehand what the results of a pilot will be. Nevertheless, a series of variables (or indicators) can

be pre-determined and these will enable essential criteria (as defined by those leading the ICT strategy) to be tested and measured [3]. It is important that educational establishments as well as other organizations clearly distinguish between piloting and progressive or phased deployment. It is a mistake to think of them as one and the same. Pilots are implemented for learning purposes, so that initial expectations can be

TABLE I  
IMPORTANCE AND RELEVANCE OF PILOT PROJECTS

Factor	Description/Meaning
Scale Testing and Evaluation	Before investing in a large-scale project, testing its assumptions on a smaller scale enables organizations to be better equipped for planning and executing larger scale deployments.
Mistake Propagation	Educational institutions and other organizations can reduce the risk of propagating mistakes by detecting errors at the pilot stage. For example, Polytechnics in Ghana can test if the ratio of 1:2 computers-to-students in a computer laboratory is an appropriate ratio based on student and lecturer responses.
Impact of Technology	Pilots can be used to assess the impact of the technology on educational establishments, people and communities, to ascertain whether equipments are used effectively by students and lecturers/teachers, etc.
Funding	It is easier for educational institutions and other organizations to secure funding for a pilot than a large scale deployment. The pilot can provide the evidence needed to secure more funding or to justify greater expenditure on specific areas such as personnel or baseline studies.
Experience	Project team members and project managers can gain more experience through piloting before engaging in a more demanding project.
Comparison of Similar Project Solutions	Pilots can be used to compare two or more similar solutions in order to find out which one works best in a particular field. For example, they can be used to test two similar computing devices or educational software packages for e-Learning in a Polytechnic’s computer laboratory at the same time and in similar environments.

adjusted and an informed decision can be taken regarding the execution of the project on a larger scale [3]. It is worth noting that pilots are NOT the first phase of the large scale deployment, since the deployment per se will start once the final project documentation is completed. Nevertheless, the same factors must be considered during planning and execution of a pilot, but factors such as costing and logistics need not be considered so stringently [3]. Table I shows the relevance of pilots and why pilots are important.

### C. Planning ICT Pilot Projects in Educational Institutions

As enumerated above, a pilot involves procedures of testing a theoretical model on a small-scale level, in order to discover potential problems that otherwise would not be detected until full-scale deployment. If these potential problems are not

<sup>1</sup>www.nuhat.org

<sup>2</sup>http://www.youtube.com/

detected on time, it can cost a lot of money and time to introduce changes once the solution has been deployed to more educational institutions. Pilots' are very different from the first stage of a progressive deployment and demand a definite type of planning [3].

Piloting of ICT projects are likely to succeed if the piloting procedures are executed correctly and the results achieved (whether negative or positive) are reliable. Positive results prove a theory is correct. Negative results are achieved in cases where the initial theory is disproved [3]. However, results of 'negativity' in piloting ICT projects can save educational institutions such as Ghanaian Polytechnics from engaging in unsuccessful implementations on a large scale.

In a previous work of Asabere [4], a detailed description of how ICT can be used to improve Polytechnic education in Ghana was presented. The work in [4] specifically tackled ICT for Education (ICT4E). A possible reflective scenario of how Polytechnics in Ghana can define "success" or "make a difference" of an ICT4E pilot project is described below.

The potential of ICTs in Education is to create change in three areas: (i) improving educational management (ii) improve the quality of teaching and learning and (iii) increasing access to education. In such a scenario, there are two other dimensions educational institutions can consider i.e. improving efficiency and reducing costs. However, educational institutions such as Polytechnics should know that technology needs to be situated within the context of a country's educational objectives [1]-[3]. Therefore in educational institutions, the 'success' of an ICT project intervention would depend on the degree to which the integration of a tool allows the attainment of educational objectives – and thus justify the investment choice of one particular tool over another [3]. A pilot ICT project requires the same degree of planning as any project in order to ensure success. Similar to any other project, a pilot ICT project, requires the pilot's: objectives, scope, tools, logistics, implementation details, installation details, funding sources, support details, maintenance plan, replacement plan, team/project member profiles and responsibilities. Additionally, both timeline and budget details have to be well documented [1], [3].

One of the key tasks that has to be planned is the development of the Monitoring and Evaluation Plan or M&E Plan. M&E is the process of measuring the outcomes of the pilot in order to match them to the educational goals of the institution [1], [3]. The M&E Plan should define the data to be collected and how is it going to be collected. The variables that will be analyzed by the project team members are called "indicators". A pilot is set-up to test some hypothesis. The M&E Plan involves the procedure of validating how well a particular theory adapts to the educational establishment's reality [3].

### III. ICT PILOT PROJECTS IN GHANAIAN POLYTECHNICS

In this section, the paper initially presents a brief history, mandate and challenges of Polytechnics in Ghana and

elaborates on how ICT can help them achieve their mandate. Additionally, the paper discusses an adoptable system-wide approach that describes how Polytechnics in Ghana can pilot ICT projects before large scale deployment.

#### A. Brief History, Challenges and Mandate of Polytechnics in Ghana

Successive Governments in Ghana from the pre-independence era till today have all highlighted the importance of formal education as a catalyst to rapid national development. Hence, the colonial government placed a premium on education, especially, technical education. This explains the establishment of technical institutes in the 1950s to train the needed technicians and technologists for the accelerated development of the country. It is worthy to note that to meet the needs of the rapidly expanding railway lines and mining activities in Ghana, technical institutes were established in Accra, Takoradi and Kumasi [13].

In 1963, the Technical Institutes in Accra, Takoradi and Kumasi were elevated to Polytechnics without any legal backing. Two others Technical Institutes in Tamale and Ho were also elevated to Polytechnics in 1984 and 1986 respectively [13]. Cape Coast Polytechnic which was planned as a Polytechnic from inception was opened in 1986 [14]. These six second-cycle Polytechnics were elevated to tertiary status under the Polytechnic Law of 1992, without any upgrading in terms of facilities or staff. Subsequently, in 1997, Sunyani and Koforidua Technical Institutes became Polytechnics and also enjoyed similar tertiary status. The establishment of Bolgatanga and Wa Polytechnics (in 1999 and 2000 respectively) ensured that there is a Polytechnic in each on the ten administrative regions of Ghana [13].

As tertiary institutions, Polytechnics have had to face a myriad of challenges in the last decade. These include [13]: (i) poor funding, (ii) inadequate staffing, (iii), inadequate staff/student accommodation, (iv) retrogression of curriculum development, (v) retrogression of career prospects, (vi) poor remuneration, (vii) lack of autonomy and (viii) limited polytechnic/industrial linkages

The Polytechnic Law (PNDC Law 321 of 1992) has since 2007 been replaced by the Polytechnics Law (Act 745). Through this law, Polytechnics in Ghana have acquired a mandate consisting of the following aims and objectives [13]:

- a) To provide tertiary education in the fields of manufacturing, commerce, science, technology, applied social sciences and applied arts, etc. and
- b) To provide opportunities for skills development, applied research and publication of research findings.

The above mandate of Polytechnic in Ghana vividly indicates that the central focus of Polytechnic education is its career-oriented nature. Consequently, since ICT is a priority for teaching, learning, daily activities and management in Polytechnics, the deployment of ICTs through initial pilot projects will help Polytechnics achieve the above mandate fully or at an appropriate level.

Inadequate educational resources, lack of community involvement and insufficient/unqualified teacher and are some

of the causes that contribute to the poor state of education in developing countries. It is well known that, access to quality education and scientific knowledge is essential for creating economic growth and sustainable human development, including poverty alleviation and improvement of human development [1], [2], [10].

In all countries and in the developing countries in particular (in which Ghana is not an exception), there is a need to employ Information and Communication Technology (ICT) to gain global access to learning. ICT can address issues of educational equity, social exclusion and can deliver more effective and accessible educational opportunities. It can also reduce cost of reaching and educating many rural students who are deprived of creative education due to lack of qualified teaching force [10].

#### B. The System-Wide Approach for Piloting ICT Projects in Polytechnics in Ghana

The effective deployment of ICTs in Polytechnics in Ghana and indeed in any setting is a complex affair that goes beyond

purchasing of computer hardware and software. As depicted in Fig. 1, GeSCI [3] identified several key elements that must be considered if the deployment of ICTs is to have a meaningful impact. These components must co-exist and none of them are optional. Together they conform to a *system-wide approach*. It is important for Polytechnics in Ghana to note that this approach has to be comprehensive, demand-driven, efficient and well-coordinated.

In the *system-wide approach*, Polytechnics in Ghana have to initially set/state their clear educational objectives as described above, through their leadership/management in consultation with their ICT project management team(s). In the next step, various ICT projects such as ICT connectivity and platform for computer laboratories and offices as well as ICT contents and applications for staff and students, which are required to meet the mandate of the Polytechnics are embarked upon on a small scale. As shown in Fig. 1, during this step, Polytechnics in Ghana have to also provide different types of support consisting of maintenance and technical as well as training and usage through their ICT project management team(s). The

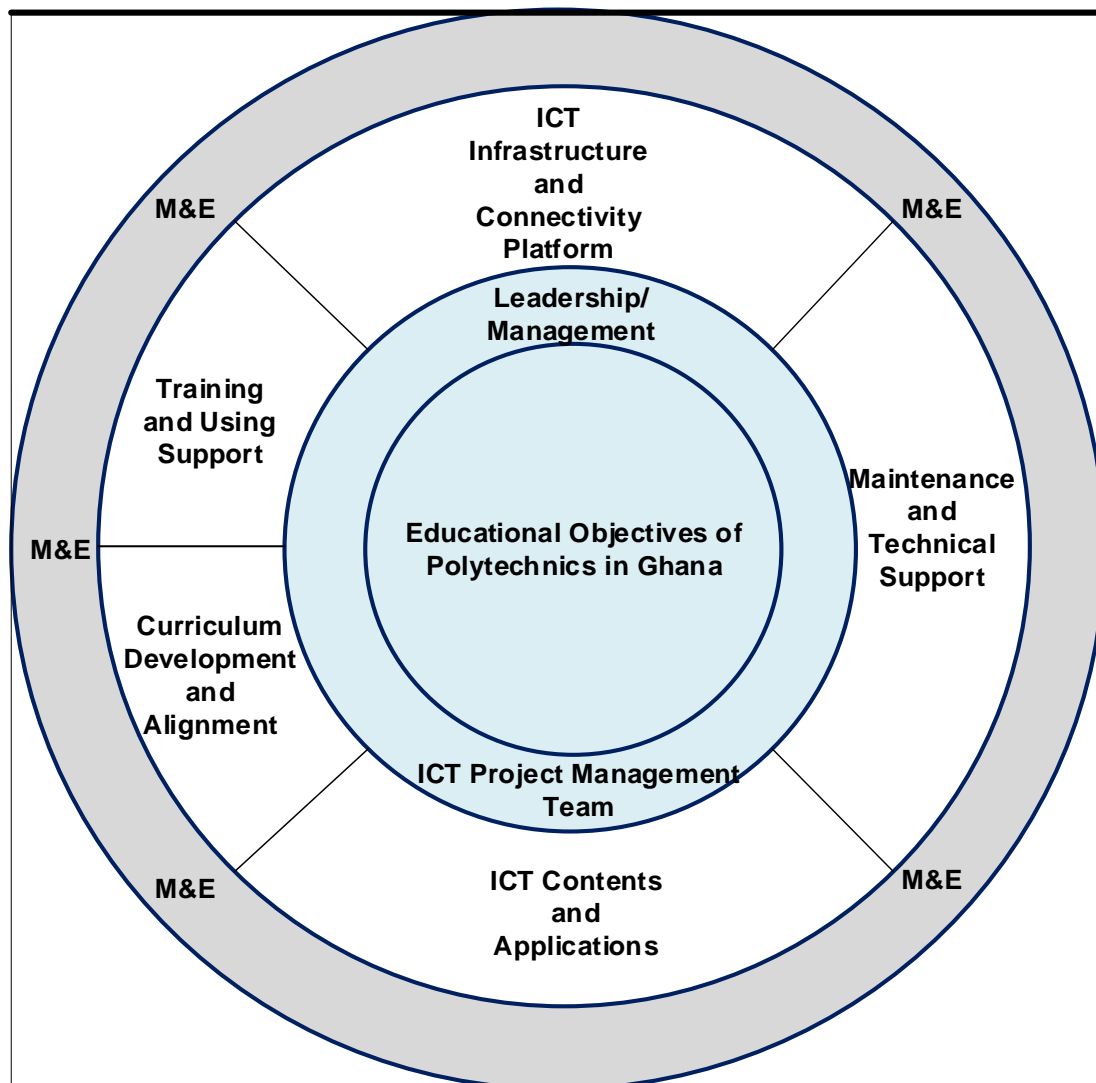


Fig. 1: System-Wide Approach for Deploying ICTs

final step involves the M&E Plan. The M&E Plan encompasses the procedures of validating how well a particular theory (ICT pilot project) adapts to the educational institution’s mandate/objective [3]. Therefore, the M&E section of Fig. 1 will authenticate whether the pilot testing results of the ICT project was negative or positive to enable the ICT project management team decide on a large/full scale deployment or another re-pilot procedure.

IV. RESEARCH DISCUSSION

From the above sections of the paper, it can be realized that piloting of ICT projects before large scale deployment is very important and necessary. In order for Polytechnics in Ghana to achieve their documented mandate, successful deployment of ICT projects (pilot of large scale) have a role to play. It is also very important for Polytechnics to analyze the actual difference between ICT pilot projects and deployment of ICTs on a large scale. These differences are depicted in Table II. Additionally, Polytechnics in Ghana have to ensure success of piloting ICT projects before they deploy ICTs on large scales.

TABLE II  
SOME DIFFERENCES BETWEEN ICT PILOT PROJECTS AND LARGE SCALE DEPLOYMENT OF ICTS

Factor	Description/Meaning
Project Execution	ICT pilot projects are strictly executed for learning purposes so that initial assumptions of the project can be adjusted and informed decisions of the ICT project management team can be taken for either an onward execution of the project on a larger deployment scale or a re-pilot procedure.
Deployment Phase	An ICT pilot project is NOT the first phase of an ICT large scale deployment procedure. It is a mistake for educational institutions to frequently believe that an ICT pilot project is just the start of the large scale ICT project. This assertion isn’t true, because ICT pilots are designed to test the feasibility of implementing the main large scale project. Therefore, educational institutions have to adjust expectations to the fact that the ICT pilot project might show the proposed solution to be inadequate for local conditions.
Funding and Cost Issues	There is a reduction of cost in ICT pilot projects in comparison to deployment of ICTs on a large scale. This is because in comparison to large scale deployment of ICTs, the test nature of ICT pilot projects requires a lesser number of resources, participants and equipments.

The “success” of ICT pilot projects in Polytechnics in Ghana can be defined as the smooth running of the pilot by using a satisfactorily selected sample of staff/students and producing results that can be trusted for the variables/indicators selected in the M&E Plan [3]. Some procedures that must be followed by Polytechnics in Ghana to ensure that ICT pilot projects run smoothly and yield valid results are as follows [3]:

- Embarking on an ICT pilot project does not mean that educational institutions shouldn’t plan at all and undergo the ICT pilot project in order to see how the real project should be planned. Planning of ICT pilot projects will save Polytechnics in Ghana lots of time and reduce the problems, which will enable them to concentrate on the user’s experiences.
- Polytechnics in Ghana should carefully select staff and students in such a way that it represents the aims of the ICT pilot project or the effective outcomes of the ICT pilot project.
- Polytechnics in Ghana should have an M&E Plan in place and the indicators to be measured have to be properly defined. Additionally, the ICT pilot project team in various Polytechnics have to be thorough and honest in collecting the required data to measure the indicators.
- During piloting of ICT projects, Polytechnics in Ghana should not discourage the importance of the human factor. It will be a very serious mistake for the ICT project management teams to convey to participants that the only results achieved from the ICT pilot project test were positive ones. This might result in participants hiding problems which will result in so-called “successful” pilots with disastrous large-scale consequences. It is also important for the ICT project management teams of Polytechnics to explain carefully to all participants the objectives of the pilot and also make it clear that it is not their fault in case there are negative results. Furthermore, the ICT project management teams of Polytechnics should make sure that the participants have the required tools to report both positive and negative results.
- Polytechnics in Ghana shouldn’t rush in the timing of ICT pilot projects but give pilots the right time they deserve. There should be a provision of enough time such as a semester or during long vacation, so that significant results can be achieved and potential problems can also be detected.
- Polytechnics in Ghana should also note that an ICT pilot project must not be used for a certain technology company to support the sales pitch for their products. Polytechnics shouldn’t allow the company providing the hardware, software or solution to interfere with the pilot, or the results can be biased. Additionally, Polytechnics shouldn’t necessarily trust the pilot documentation of only one company but compare with others and also run the ICT pilot projects themselves.
- If Polytechnics in Ghana want to test computer labs to be used by their students, they have to initially assess the various hardware and software requirements of their students. This should be done in consultation with the

various practical ICT/IT/Computer Science programmes run by different programmes in the Polytechnic and the software required for such programmes. The ICT pilot sample (software, hardware, students or lecturers) should NOT be selected based on gender, unoriginal, dictated and bribery/corruption grounds, which are common occurrences in many countries, as this will most likely produce biased results. It should also be noted that the ICT pilot sample cannot be too small, since in this case the data collected might be too partial, nor should it be too large and difficult to supervise [3].

## V. CONCLUSION

This paper described and presented a guide on how Polytechnics in Ghana should encourage piloting of ICT projects before large scale deployments. Using relevant literature, the necessity and importance of piloting ICT projects in educational institutions as well as its planning with a focus on Polytechnics in Ghana were outlined. Through the adoption of the system-wide approach described in this paper, Polytechnics in Ghana can successfully embark on ICT pilot projects for onward deployment of ICTs on a large scale, if the results of the pilots are positive. To ensure the success of ICT pilot projects, Polytechnics in Ghana have to follow the steps elaborated in Section IV of this paper in order to achieve positive pilot and large scale deployment results in terms of ICTs.

This paper therefore recommends that Polytechnics in Ghana should embark on piloting their ICT projects so that they can achieve successful deployment of ICTs on a large scale. Furthermore, there is a lot of work (such as the various steps in the M&E Plan) involved in piloting an ICT project which couldn't be covered in this paper. Therefore, as a future work, Polytechnics in Ghana should embark on enhancing the training of their staff (especially ICT Departments) in terms of piloting ICT projects. Additionally, Polytechnics in Ghana should encourage the formations of ICT project management teams for the future deployment of successful ICTs in their institutions.

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