**Conference on Applied Research and National Development**

**Koforidua Polytechnic**

**14th July, 2015**

Keynote Speech

Introduction

Let me begin by expressing appreciation to the Rector and management of this Institution, Koforidua Polytechnic for this unexpected, probably undeserved invitation, to share with you, my own thoughts at this conference on Applied Research.

I am really impressed by the prospect of polytechnics in the nation, mainstreaming research, and not allowing it to be the sole preserve of universities, research institutes and think tanks. You are moving beyond the frontiers of polytechnics as simply being preoccupied with teaching and learning a variety of technical skills. It is of course clear that not a single aspect of teaching and learning in academia can be successfully prosecuted without research, or deep inquiries and investigations before one reaches conclusions.

I note with gratification that conference concept has grown over the years into its current form, from humble beginnings in 2008, into this monumental outcome in recent times when it attracts scholars from far and near.

But your conference theme is very logical and invites critical thinking, since opportunities for knowledge construction, and the construction of new knowledge, typical of tertiary institutions, should naturally leave room for knowledge application, and application of research, for the benefit of the nation as a whole.

Progressive

But I note a few other progressive developments, which gratify me a lot: I have mentioned the mainstreaming of research in polytechnics. I also note your collaboration with a tertiary institution in organizing this conference. The Methodist University College should feel proud to have been noticed, and invited to be partners in this endeavor. It demonstrates clarity of vision on the part of the management in Koforidua, but also helps to condition the structures of a polytechnic, as it prepares the ground towards a possible transformation into a technical university. Hobnobbing with progressive universities in academic events and programming, ahead of being upgraded into a university is simply smart thinking. It enables the cross fertilization of opinion with universities; and in this case, more significantly between the public and private sectors in education. Regardless of where you belong, whether the public or private sector in

education, the fact remains that education is a public good, whether or not it is prosecuted by the public or private sector.

The attempt here to provide a forum to share research findings, across geographical, disciplinary, and educational frontiers is highly appreciated then.

## Shortage of Data from Africa

Above all this is the importance of research in renewing the content of curriculum across all levels of education. New knowledge and innovation help to inject new life into teaching and learning. At the level of tertiary education, the more new knowledge we introduce to students, the more we get students to be more and more inclined towards research, independent thinking, and the urge to cultivate originality, and intellectual creativity. As a country, as a continent, we are simply fed up being stereotyped as perpetually hooked to quaint and outworn knowledge, indeed as institutionalizing the recycling of obsolete, imported ideas, even if these are of no relevance to our local circumstances.

Is there no new research happening on our continent? Yes, there is new research, but probably not enough.

The global village acknowledges that there is not enough evidenced-based research coming out of universities and think tanks in Africa. Most often it is said, Africans have had to rely on US data on Africa to do its planning. Data on Africa by Africans is lacking; and I was embarrassed reading an essay a few years ago, in which an African scholar in his attempt to determine the Muslim population in Ghana, cited figures and statistics that he attributed not to a Ghanaian source, but to the CIA.

Ask any think tank, government agency or even the Statistical Service about the statistics of unemployment in Ghana: the percentage of unemployed in Ghana, and you will draw a blank.

The most embarrassing case was last year during the Ebola outbreak, when Africa had to rely solely on US data. We had to turn to USA for data on an outbreak of catastrophic proportions that threatened to wipe out the continent, or at least had major implications for Africa's economy and its collective productivity. But for the US data, we would probably have been in the dark about the scope, spread, proportions, and indeed prognosis on Ebola in Africa.

In the absence of data, one cannot vouch for the credibility of national policy formulation and national planning. Our sense of planning has been noted to be rather haphazard. Ask anybody in Ghana here, for the estimated population of Sodom and Gomorrah, or Agbobloshie, which may have been dislocated as a result of the recent major demolition exercise, resulting from the historic flooding of Accra. And upon what statistics and research, has planning been done to determine the appropriateness of a possible resettlement at Pokuase? In all the saga of Sodom and Gomorrah, what one missed was statistics on the population.

Check the UNDP initiative on the Human Development Index, which gives the respective markers on progress of countries in various areas of development: education, health, population, etc. and you find blank spots against many Africa countries in one type of data or another. Data on Africa upon which assessments on human development can be made is either limited or unavailable in some cases.

Africa is thus a continent of shortages and disasters: shortage of food, shortage of technical skills, but also shortage of data about ourselves, about our circumstances. And as if wars and other disasters are not enough, one can refer also to research and data gathering as another area of disaster. Either the data is not there or it is simply not reliable.

A recent report at a conference on climate change, entitled 'Africa facing data shortage,' noted that,

'There are some countries with data on climate change, and water related issues, many others without... Even where data does exist, the level and depth of coverage may be found wanting because of a lack of technological tools. Analytical tools such as software to analyze and map information from the field was lacking in many African countries.'

Our challenge is not just with data gathering and research, but also with analytical skills needed to explain and analyze data collected.

Indeed, as Kofi Annan said at a recent Summit on African Higher Education in Dakar, 'Governing a country without data, is like driving a car without a dash board.' The outcome of course can only be disastrous.

Research, whether basic or applied, is imperative in all aspects of life.

Research Culture

But as a continent, do we in Africa have a negative research culture? Do we not have a sufficiently inquiring mind? Do we suppress children's sense of inquiry? Do we not rebuke children with inquiring minds? That would otherwise be the genesis of a search for knowledge; the search for information to satisfy curiosity, and at a formal level for purposes of seeking solution to issues, and subsequently for planning.

Developing a research culture in all aspects of life reduces speculation and helps to reach conclusions that are based on empirical realities.

Years ago when I visited USA on sabbatical leave, I was amazed how primary school pupils at the level of Class 3 in Philadelphia, including my own

daughter, were given a home work the level of which baffled me as a Ghanaian, an African in a wonderland. But that was a routine in USA, I later learnt. The Class 3 kids at the University of Pennsylvania Primary School in Philadelphia were required as a home work, to put a raw egg in a glass of water, and progressively add limited quantities of salt. That led to a steady rise of the raw egg up the glass of salted water. The children were required to measure the amount of water and salt that it would require to keep the raw egg afloat, and explain the principle behind the observation. Pupils were indeed asked to take pictures of the home experiment at every stage of the process with the help of parents, and do a poster exhibition in class the following week. And that was at the level of Class 3. I sincerely wished that had happened in Ghana; it would have informed me how early we in the Third World could cultivate at an early age the culture of research, science, experimentation, academic inquiry, or even simply curiosity.

If children of that age would be ushered into a world of scientific research, just imagine how early research in science and technology would become part and parcel of children's daily lives.

Expenditure on Research

But should we surprised at the low level of research at the formal level in Africa.

A lot could be ascribed to the relatively low participation in tertiary education as a whole in Africa, as well as the low public expenditure in the tertiary sector. While the higher education participation rates in many high income countries are well over 50%; in sub-Saharan Africa, the participation rates in most cases are below 5%. The

low level of participation in tertiary education should naturally have adverse effects on development, for there is increasing evidence that high levels of education in general and of higher education in particular, are essential for the design and optimum uses of new and innovative technologies, as well as the development of civil society. Lamentably, there is evidence that per capita spending on higher education has fallen in Africa over the years. Public expenditure per tertiary student has fallen from $6800 in 1980, to $1200 in 2002, and recently averaged just about $981 in 33 low income sub Saharan African countries.

But not only is tertiary education crucial in national development; research specifically is critical to national development; and benchmarks have been recommended for expenditure on research the world over, if national development targets should be attained. Currently, a country like Israel, has a research budget of 4.2% of GDP, South Korea has 3.74%. When it comes to Africa, the outcomes are different. South Africa's budget for research is 0.7% of GDP. Ghana's budget for research is currently 0.3% of GDP, far below the benchmark prescribed by the Africa Union, which is 1% of GDP.

Relevance and Development

But I am also enthused about your efforts to link research to development, research to industry, and your curious search for relevance in tertiary education. Your search for relevance also works the other way round: the need for industry not to oversimplify the search for the right caliber of personnel in tertiary education. The issue of relevance can be more subtle than sometimes

anticipated by industry.

But your theme in closer reading, goes beyond research. It really applies to various academic disciplines in academia; it refers to disciplines associated with applied research and those dealing in basic research. But it also refers to graduates, employment, getting jobs to do, and the kind of academic training required to get you a job, on a competitive job market.

But the theme also invites a subtle distinction between national development and employability or word relevance. If the STEM disciplines: applied science, technology, engineering, and mathematics are applied disciplines, are they same as being professional, and are they the same as quickly getting you a job?

But the popular sense of what is deemed relevant in academia is sometimes interpreted in various ways; and several universities in Africa, have been compelled to mount courses that are perceived to be more relevant than others, and also perceived as more capable of getting jobs for students.

Thus universities in East and West Africa a few years ago ventured into course combinations that were supposed to attract higher enrolments, and enable students to more quickly land jobs. Thus humanities courses that were supposedly of limited relevance to national development, were systematically yoked or joined to courses perceived as having higher relevance. Thus combinations like the following became very popular in parts of East Africa: dance/chemistry, theatre arts/international diplomacy, classics/international affairs; religion and communication studies, etc.

These combinations were constructed to expand the turf of employment for graduates, making them more employable than single majors in the humanities.

The situation has also fostered parochial views of national development, compelling humanities scholars to go into advocacies and consultancies, and abandoning the exercise of the intellect as an end in itself, which was originally the preserve of non-applied courses in universities. What are you going to do with History you are studying, or religion, or even political science. And this often compels the political scientist, social scientist or linguist to launch into advocacy in his intellectual work, and make recommendations to Government.

Currently, a political scientist proves his relevance to national development for the ordinary man, only if he can comment on the Talensi Bye-elections, and explain why the opposition lost the seat.

But there was also a cosmetic aspect of the whole course offering, which was frivolous, but a source of delight to students. At the University of Ghana, where I was Dean of Students and was closely monitoring student welfare and social inclinations, we realized how women were dating boys on the basis of courses offered by the boys. Between a law student and a boy offering theater studies or classics, the choice was obvious. Whether that was the students' perception of relevance, future job security, or all this was based on a perception of course popularity, it was hard to tell.

Populist

But let me agitate you further with the issue of relevance and national development, from another populist angle. If as a student, professional, or scholar working in the public domain, you want to determine the popular perception of your relevance to national development, simply advocate for you and your peers to declare a prolonged strike action, and monitor how the public reacts to your strike. Let public sector doctors go on extended strike today, and see the panic that causes in government, and among the general populace: the picture of dying or dejected patients would be enough, for Government to convene an emergency meeting through the sector minister to quickly see to the needs of doctors. Or talk of a strike by state attorneys recently: the courts were empty, and litigants and relatives were disgruntled, and stranded all over the country. The strike is probably not over yet, but you can predict sympathetic hearing by Government on the basis of the strike's capacity to disrupt day to day public life. To the public, that measures your relevance to national development.

On the other hand, let lecturers or students of universities and polytechnics go on strike, and some ignoramus will advocate that the Government should close down all universities and polytechnics and throw the keys away. Just imagine how many times polytechnics have gone on strike, fighting for a higher recognition of HND. In the 1990s, University Teachers Association of Ghana, then led by a colleague at the University of Ghana, went on strike to demand improved conditions of service. The Government turned their backs on them, and would not give in over an extended period. In the final analysis, Universities in Ghana were closed down or shut for a total one year. No one in authority was interested in the strike; for the tertiary sector was perceived as not crucially relevant to national development, whether the strikers were teachers or their students. Significantly, the strike did not affect the medical students at Korle Bu, who were still attending classes anyway.

From 1982 to 1996, a greater part of which was occupied by military regimes, the University of Ghana was closed down at least eight times. With the exception of the period from January to April 1982 (four months) when the universities were closed down to release students for cocoa evacuation, all other closures were caused by tensions between students/lecturers and Government. As a result of these disruptions in the academic calendar, the University of Ghana lost altogether 32 months, which is about two and half years of academic work. Consequently, one stream of applicants for admission to the University in 1996, missed their turn because the University was closed, and had to join the next stream. The double intake the following year is partly responsible for the over bloated student population, and until recently the close to two years of secondary school students who were compelled to stay at home, before entering the University. How relevant was tertiary education to governments in Ghana, and what was the perception of national development?

Polytechnics

Similarly, people wrongly think polytechnics are dispensable, and a nation can do without a diversity of applied technical skills cultivated at the tertiary level, among the nine polytechnics in Ghana.

In the 1990s when I was Dean of Students at Legon, and initiated the establishment of the first education/ university radio station in Ghana, later called Radio Universe, there was in incident that compelled me to take a second look at polytechnics. Our brand new transmitter, which we imported from London, broke down unexpectedly, and left us off air for a week or more. This compelled us to send a quick SOS to the London manufacturers, since there was no local expertise. Days later, I received word that a visitor was waiting for me at the reception; he had come from London looking for me, and having been sent by Roy Parsons, the CEO of the manufacturing company; was this Parson's errand boy. I took a cursory look at the gentleman, who looked rather lean and scruffy, with a slim back pack dangling behind him. I asked him his mission. He had come from London to repair the University's radio transmitter. I took a hard look at him, and was doubtful and suspicious. His name was Tom, a 17 year old polytechnic student in one of London's polytechnics doing his practicals. Within 90 minutes, 17-year old Tom repaired our transmitter and headed for the airport to catch the next flight to London.

For those who think polytechnics are dispensable, and should all be converted to Technical Universities to visibly establish their relevance, there is room to revisit the idea. We may return home one day to find a missing generation of middle level skillful technicians replaced largely by a set of theoretical skills.

But the need for research scientists and academics in nation building was long anticipated by the Founders of our nation state. At the recent summit on higher education in Senegal, this caution was thrown again and again.

Research and National Foundations

Indeed, founders of the nation-state Ghana saw research as so crucial to national development that in 1959 Osagyefo Dr Kwame Nkrumah formed the Ghana Academy of Arts and Sciences, the very first in Sub-Saharan Africa, charging it with the

responsibility of promoting standards in the teaching and study of the sciences and humanities.

Nkrumah ensured that the foundation membership of the academy was broad in scope, and represented a rich variety of professional talents, whose research output would be necessary to provide a solid foundation to anchor the multiple realizations of national development.

The Foundation membership, one of whom is still alive, was a careful selection of trail blazers and standard bearers, indeed quintessential embodiments of learning and practice. It was these that could promote and perpetuate academic excellence, and enrich the foundation of national development. The fact that Nkrumah himself was a fellow of the Academy, and located the Academy's secretariat at the Flagstaff House, the seat of Government demonstrated the Academy's considered significance as a national asset, and the importance of research in national development.

Alongside the GAAS, Kwame Nkrumah also established in 1958 the National Research Council which later transformed into the Council for Scientific and Industrial Research. This Council, formed soon after independence was charged with the responsibility of carrying out scientific and technological research for national development. It was meant to organize and co-ordinate research in Ghana and provide the necessary platform for Ghana's accelerated development. Its governing council was chaired by President Osagyefo Kwame Nkrumah himself.

It is significant that Kwame Nkrumah found it imperative to be in direct charge himself, of the two research institutions he established: the Ghana

Academy of Arts and Sciences, a primarily learned society, and its scientific research wing, the CSIR. This was meant to signal the priority of research in national development, and to ensure that the two institutions would remain focused and attract the necessary support needed to prosecute their statutory mandates.

Significantly, the two academic institutions still remain vibrant, with the Academy having benefited from a government grant to build its new Headquarters, which was recently inaugurated.

The academy and CSIR have been in media highlight in the past few months. In May this year, the Academy publicly joined the famous Ebola debate, when after very careful investigations and painstaking research, they organized a press conference to raise issues about the Ebola vaccine trials in the Volta region. Significantly, it was their viewpoint which guided the decision of Ghana's legislature to order a suspension of the trials.

A few weeks thereafter, it was the turn of the CSIR to hit the headlines in protesting the planned resettlement of the displaced people of Sodom and Gomorrah at a site in Pokuase earmarked for the CSIR, for research purposes. The Council protest was reinforced by street demonstrations by staff of CSIR.

Academia and Industry

With all the strong foundation given to research by founders of this nation state, one would have expected a strong research output as a nation, as well as much closer links between research institutions and policy makers; academia and industry, and closer collaboration between policy makers and universities. Indeed the idea behind a

council for scientific and industrial research was to link scientific research directly to industrial needs, and enable industry to directly benefit from scientific research. Yet the gap between tertiary institutions and industry appears to be widening from decade to decade, and the unemployment market is getting bigger by the day. Research outcomes continue to sit on shelves, even as policy makers grope for evidence based research upon which to ground policy formulation.

The latest figure on graduate unemployment I read, and credited to Legon's Institute of Statistical Social and Economic Research (ISSER) is 200, 000. This year alone, the number will swell up by 71,000 made up new graduates to be churned out during the year. Is there any wonder now that there is an Association of Unemployed Graduates?

Interestingly, ISSER has observed a reverse correlation between education and unemployment, saying the more educated you are these days, the more likely you will be unemployed. If indeed education moves you farther and farther away from employment, the yearning for continuous education.

According to ISSER, Ghana is sitting on a Time Bomb with its worsening unemployment situation. We need not forget the genesis of the Arab Spring, where a graduate in a retail business in Egypt, selling his wares at the street side, was driven away by the local law enforcement agencies. Out of desperation, he set himself ablaze, eventually sparking a chain of popular uprisings and revolutions that engulfed the whole of the Middle East and beyond, and led to civil strife and the overthrow by the masses of several undemocratic and dictatorial regimes.

The Gap

Factors often listed as responsible for the gap between academia and industry include the mounting of programs as well as the use of obsolete academic curricula that are ill suited for the job market; the lack of consultation between academia and industry; the over concentration of strait jacket ideas within the curriculum: indeed a complete disconnect between education and the job market has been cited.

This is coupled with a perceived absence of linkages between the national vision of development, and respective institutional visions in academia. Indeed, it may be asked, how many tertiary institutions in Ghana formulate their visions and their strategic plans in close consultation with the national vision as stipulated in the national development policy framework?

Many state agencies have time and again expressed the need to make tertiary education more responsive to national needs. The medium term national development policy frame work alludes to this, so does the National Council for Tertiary Education, and the Association of Ghana Industries. The most recent initiative is that of a famed industrialist and architect, Rockson Dobgegah, who has undertaken a major initiative of linking academia to industry through a series of projects. And we dare not forget the Conference held last year by the Ministry of Education with academia and stakeholders of industry that sought to formulate policies towards mutual co-operation.

A recent research initiative by five scholars in Legon, that sought to address the issue of academia and industry came up with significant findings. The

study discovered a complete mismatch between job skills requirements by firms and skills offered by tertiary graduates. They noticed a noticeable absence of certain key skills among graduates, including the lack of skills to analyze data/situations and propose solutions; the relative absence of leadership and innovation skills; and the dearth of technical skills. Other lapses observed after surveying tertiary institutions and firms within Greater Accra, the Association of Ghana Industries, government agencies, National accreditations Board, NABTEX etc, included perceived limitations in oral and written communication skills, the capacity for team work, numeracy as well as IT skills. These lapses were observed across board.

The mismatch between academia and industry is such that several industries have been compelled to retrain graduates they have employed, in their training schools, to orient them towards specific industrial expectations. The effect of the perceived mismatch has often led to low industrial growth and the swelling of budgets of industries for capacity building or the further training of graduates. This added training naturally leads to higher costs of production in industry that are eventually passed on to the consumer.

This situation of mismatch is often regardless of programmes or courses offered by the new graduates, as to whether these are humanities, basic sciences or applied sciences. Even with courses in the applied sciences, industry has still complained of a disconnect, even at the level of internships, and expressed the need for closer collaboration between for example hospitals and academic institutions from where trainee nursing students are coming.

Conclusion

But a mismatch between academia and industry does not necessarily mean over all these years no steps have been taken to address shortcomings. Partnerships with industries have been forged by universities and polytechnics at various levels in Ghana, except that these have been few and far between, and have been incidental, and hardly formulated as firmly grounded institutions.

The industrial hubs in Tema, North Kaneshie, and Suame Magazine, and Kokompe, as well as telecommunication hubs should be available for long term partnerships, in much the same way as the Research Triangle in North Carolina in USA, has developed firm linkages and alliances between key academic institutions within the region and industry in North Carolina.

I am simply saying we should intensify and institutionalize the job fairs; we should not allow job counseling centers to be incidental one off sites in tertiary institutions, but institutionalized centers handled by qualified personnel. And let job fairs move away from casual ad hoc events. Let these be organized by consortiums of tertiary institutions, dealing with organized industrial bodies, that identifies specialists and puts them in the service of institutions.

We should go beyond this, to ensure representation of men and women in industry on the governing councils and governing boards of universities and polytechnics.

Let us not be complacent with token internships. Let's formulate internship agenda that immerses trainees in the world of work, allows complete immersion and empathy, as well as sincere passion for the work of industry.

Above all, follow-ups by academic institutions on the work of field trainees as well as seeking feedback and reports from supervisors are as important as the placement segment of the exercise. It enables early interventions and the quick application of corrective measures, where trainees are perceived to be going astray. Many institutions have not done follow ups on interns and have sought to end the exercise by simply dumping interns at the place of work.

Above all let's institutionalize tracer studies in the country, where tertiary institutions follow up on the progress of their graduates in the world of work, to determine the adequacy and relevance of the training imparted, with a view to improving the curriculum.

By so doing, we would be reducing the perceived gulf between research, academia and national development.

 I wish you fruitful deliberations at this conference.

**TOPIC: Conversion To Technical University: The Practitioner's View Point.**

**Government and President of Ghana**

On Tuesday January 6, 2015, Citifmonline.com reported on the **"Converting Polytechnics into Universities: Gov't to engage stakeholders" It said** "President John Dramani Mahama will chair a stakeholder forum aimed at working out modalities to convert Polytechnics into Technical Universities today. The forum was under the theme "Repositioning technical education as a driver of economic transformation and national development". Top academicians and educationalists across the country were meeting to devise measures to ensure the conversion. The conversion of polytechnic into technical universities was one of the manifesto promises of the Mahama administration ahead of the 2012 elections.

The report further said, the aim of the conversion is to "create more opportunities for students desirous of acquiring higher academic laurels and repositioning polytechnics as strategic institutions for the training of highly skilled human resource. The rationale behind the conversion was to also achieve parity of esteem with the universities without departing from the practical-oriented philosophy of polytechnic education and training.

**Deputy Minister in charge of Tertiary Education, Hon. Samuel Okudjeto Ablakwa**

Deputy Minister in charge of Tertiary Education, Hon. Samuel Okudjeto Ablakwa dropped the hint, at the 10th Graduation ceremony of the Africa University College of Communications (AUCC) in Accra that, Polytechnics are to be converted into universities in 2014 with the intention to "create more opportunities for students who are desirous of acquiring higher academic laurels".

**Converting polytechnics into Technical Universities – Critical Issues that must be addressed. By Alex Frimpong, CEO, Ghana Employers' Association**

In 2011, the Ghana Employers' Association (GEA) conducted a survey to ascertain the extent to which polytechnics in Ghana were fulfilling their mandate of training professionals with skills needed for industry.

The survey also indicated that 60 percent of students graduated in programmes in the humanities as compared to 40 percent in the sciences.

Polytechnic education emphasizes the **_application of knowledge rather than the search for new knowledge._** The thrust of polytechnic training is, therefore, the *acquisition of the relevant skills required to perform specific professional tasks without ignoring the underlying theoretical knowledge necessary for a proper understanding of the tasks to be performed.*

**Critical questions**

Why has there been a "mission drift"? Why have our polytechnics focused on the humanities instead of the sciences? Is there enough funding for polytechnics in the science related programmes?

Specifically, the mission of the polytechnics is to, among others; **provide tertiary education in the fields of manufacturing, commerce, science, technology, applied social science, applied arts and any other field approved by the Minister of Education.** Polytechnic education is also **aimed at providing opportunities for skills development, applied research and publication of research findings.**

**Polytechnics today**

Ghana's Polytechnics Act 2007 (745) clearly states that the mission of the institutions as **skills development in the fields of manufacturing, commerce, science, technology, applied social science and applied arts with emphasis on skills development and applied research.** However, polytechnics have been accused of "mission drift". The courses offered and student enrolments are skewed towards the arts and humanities with only about 30 percent of the students enrolled in science and technology programs.

This is a huge concern to employers since the institutions created to serve the needs of industry

have abandoned their core mandate to the detriment of industry. Employers increasingly cite deficiencies not only in up-to-date technical skills training of job applicants, but also in the "employability skills", creativity, problem-solving skills, teamwork, leadership, self-esteem and integrity that are indispensable to productivity in today's workplace.

The government, recognizing the need to address the deficiencies and gaps in polytechnic education put in place a technical committee to look at the conversion of polytechnics into technical universities.

The committee in its report stated that the Technical Universities (TUs) will have the following mandate among others:

1. Provide education and training for the world of work: students are trained to acquire high level employable skills for wage or self-employment
2. Have strong links with industry and business
3. Support existing and emerging productive sectors of the economy with technical expertise and R&D
4. Will be focused on practical research activities, including industry and market-driven joint research projects
5. Offer programmes that are vocationally oriented or career focused
6. provide skills training at all levels: certificate, diploma, degree, and post graduate degree levels
7. Offer courses and programmes covering a wide range of economic activities
8. Place emphasis on innovation and application of new technologies including ICT
9. Provide skills training from the middle level to the highest level possible

**Employers' views**

The main concern of employers in the conversion of polytechnics to technical universities is whether or not they will train the high level technical skills needed for Ghanaian industries since polytechnics

had a similar mandate but drifted from that and started training more people in the humanities and not the science/technical areas.

Employers, therefore, agree with the technical committee that for a polytechnic to be converted into a technical university it should run a minimum of four (4) BTech degree programmes which should be skewed in favour of science and technology based disciplines.

Secondly, employers recommend that in the conversion of the polytechnics to technical universities there should be clear policies and regulations to prevent the new institutions from deviating from the desired objective of providing technical training and skills development of the kind that are not currently available in the traditional universities.

Thirdly, the technical universities should focus students' training on technical areas needed by industry and should therefore collaborate with industry in the design and implementation of their courses of study.

It is further recommended that the technical universities should be mainly technological institutions that will impart entrepreneurial and employable skills to students, to enable graduates to apply their skills in research and technology to solve problems in business and industry.

It is also suggested that in order to address the deficiencies and restore Ghana's skilled workforce, we have to keep polytechnic education current and relevant to industry needs. We also need to upgrade the public perception of technical education students.

Moreover, business and industry should show support for best technical education programmes and in the same vein TUs could tap from the rich experience of industry practitioners in teaching and research.

Employers have no qualms with the conversion of polytechnics into technical universities as long as they fulfill their mandate and supply industry with the required skilled manpower needed for Ghana's economic growth.

POTAG – Kumasi.

Converting polytechnics into technical universities - the road map

The Polytechnic Teachers Association of Ghana (POTAG) - Kumasi, wishes to acknowledge the pronouncement of the President of the Republic of Ghana His Excellency John Dramani Mahama of his intentions to convert the Polytechnics into Technical Universities.

It will be noted that the President in delivering the State of the Nation's address, under Pillar one - Putting People First, stated his government's resolve to convert the Polytechnics into fully fledged Technical universities. POTAG Kumasi commends the President for this bold decision.

It will however remain a decision unless concrete steps are taken to make it a reality. Whiles the idea is highly commendable, swift action needs to be taken on it immediately.

POTAG Kumasi greatly embraces the idea and is willing to cooperate fully to make this possible.

POTAG- Kumasi has gone ahead to form a Committee to help facilitate the process for the smooth implementation of this noble decision.

The Minister of Education has in recent times called for Polytechnics to come out with programmes that are more innovative and relevant in present times. Whiles this call is timely and appropriate, perhaps the conversion of the Polytechnics into Technical Universities will enable just that.

The running of relevant programmes by the Polytechnics is often challenged by the inability to obtain accreditation. It is indeed anticipated that with the conversion into Technical Universities, Polytechnics will have enough autonomy and be empowered to run the much needed technical programmes.

The Polytechnics need to fulfill their mandate of training the technical manpower needed for the industrial development of the nation, hence the urgent need for the roadmap affirmed by the

President. The advantages that would accrue to the nation are enormous.

In terms of human resource and infrastructure the Polytechnics are far ahead as far as converting them into Technical University status is concerned.

Indeed some of the Polytechnics such as Kumasi can boast of enough qualified staff for the running of technical degree programmes.

POTAG look forward to a timely response from Government to discuss the way forward to converting the Polytechnics into Technical Universities. Thank you.

Edmond Oppong-Peprah (Chairman)

**Don't hasten conversion of polytechnics to universities - Professor Joseph Atsu Ayee**

A Professor of Commonwealth Studies, University of London, Professor Joseph Atsu Ayee has advised government to discard the idea of converting polytechnics into technical universities in 2016.

According to him, polytechnics have not yet developed the necessary curriculum needed to run degree courses. The Technical Committee on the conversion of polytechnics to technical said Polytechnics will only be accredited to a technical university, if they satisfy the requirements of becoming one. But Prof. Ayee believes that various polytechnics are not conducting enough research to warrant the conversion into technical universities in 2016. He said the polytechnics had not developed the needed curriculum to run degree courses. He has therefore advised government to slow down the conversion process. Prof. Ayee, who is a former Dean of the Faculty of Social Sciences of the University of Ghana, Legon, suggested that the government should pilot the changeover in some selected polytechnics and push the commencement date for the conversion of polytechnics into technical universities to 10 years later.

Prof. Ayee's stance runs contrary to the decision by a technical committee to start the conversion of polytechnics into technical universities in 2016.

Prof. Ayee, who is also the immediate past Deputy Vice Chancellor of the University of KwaZulu-Natal, South Africa, said the United Kingdom (UK)

and South Africa converted polytechnics into technical universities, but did not develop the required curriculum to support the courses.

As a result, he said, the transformation of polytechnics into technical universities in the UK and South Africa was not that successful. "The UK and South Africa failed because they had not been able to transform the curriculum," he said.

'Hasten slowly' "I ask for a phase approach before commencement. There must be a transformation of the curriculum. We should hasten slowly. We should not rush it," Prof. Ayee said.

He said there was the need for Ghana to take a cue from the UK and South Africa.

The conversion of polytechnic into technical universities was one of the manifesto promises of the Mahama administration ahead of the 2012 elections. The purpose of the transformation of all polytechnics into technical universities is to bridge the gap between academia and industry. It is also geared towards training students with employable skills for economic transformation in the country.

## HO POLYTECHNIC READY FOR TECHNICAL UNIVERSITY (V/R)

Ho Polytechnic has beefed up capacities in readiness for the conversion of polytechnics into technical universities, Professor Anthony Afeke Adimado, Chairman of the Governing Council has stated.

He said Ho Polytechnic was aware the programme of conversion required that administrators and faculties embrace "creativity and innovation, commit to excellence in teaching and research, and forge stronger links with industry and scientific institutions across the world".

Prof Adimado was addressing the 14th Congregation of the Ho Polytechnic in Ho at the weekend.

He observed that the conversion was laudable, and would enable the Polytechnics to "produce top-notch engineers and other technologists to play major roles in industry".

Prof Adimado said Ho Polytechnic had held "several seminars and workshops for our staff on responsibilities that may arise in anticipation of the conversion in order to ensure a smooth transition."

"We have also equipped our faculties and departments to take advantage of opportunities that the conversion would bring," he stated.

Source: GNA

## SUNYANI POLYTECHNIC

Government's policy of converting polytechnics into technical universities will take-off in September 2016, to help reposition them as strategic institutions for the training of highly-skilled human resource to drive the nation's socio-economic development.

Dr George Afeti, former Secretary General, Commonwealth Association of Polytechnics in Africa and former Rector, Ho Polytechnic, said government would soon place a bill on the conversion of polytechnics into technical universities before Parliament to give legal backing to the take-off. He said converted polytechnics are not to become "traditional" universities with similar mandates or duplicate the courses and programmes that the universities are offering.

Dr Afeti, who was the Chairman of the Committee that developed the roadmap for conversion of polytechnics to technical universities, was speaking to the Ghana News Agency in Accra on Saturday on the sideline of the swearing-in of an 18 member new council and the induction of 180 new members into the Institution of Engineering and Technology, Ghana (formerly Institution of Incorporated Engineers).

He said the Committee recommended a gradual upgrading of existing polytechnics into technical universities based on criteria such as qualification level and practical industrial experience of lecturers and the collaboration of the polytechnic with industry and business.

Others are infrastructure, equipment and training facilities at each polytechnic.

He said the rationale and justifications for converting some of the polytechnics into technical universities is to achieve parity of esteem with the universities without departing from the practice-oriented philosophy of polytechnic education and training.

The former Rector said upgraded polytechnics would be required to remain focused on their core function of training technicians and technologists at a higher level to meet the exigencies of the rapidly changing, technology-driven work environment.

He said the technical universities are not to mimic the traditional universities or depart from their original mandate of training for the world of work; rather, they would provide training opportunities at all levels of skills development, in particular at higher levels.

Dr Afeti said the universities of technology in South Africa, and the universities of Applied Science in Germany, the Netherlands and Finland are good examples of such industry-focused higher education institutions.

**Excerpts from "REPORT OF THE TECHNICAL COMMITTEE ON CONVERSION OF THE POLYTECHNICS IN GHANA TO TECHNICAL UNIVERSITIES"**

His Excellency, the President of the Republic of Ghana, in his 2013 State of the Nation address, announced that the Polytechnics will be converted to Technical Universities. Students in the Technical Universities will be trained to acquire high level technical skills to drive the country's economic and national development agenda. The proposed technical universities would contribute to raising the quality and competitiveness of the Ghanaian workforce by providing opportunities for company employees to upgrade their skills and acquire new skills. The new Technical Universities would reduce the admission pressures on the traditional universities, provide progression avenues for technical and vocational students, and curb the growing phenomenon of academic-type "top-up" programmes for HND graduates at the traditional universities. Technical Universities, having a

different focus and orientation from traditional universities, will contribute to creating a more diverse and better performing higher education system.

The Polytechnics Act, 1992 (PNDCL 321) elevated the polytechnics to the status of public tertiary institutions. The upgrading of the polytechnics conferred on them the authority to award Higher National Diplomas (HND) and other certificates. Since then the institutions have had their mandates strengthened and expanded under a new Law, the Polytechnics Act, 2007 (Act 745) to offer qualifications in a wide range of applied arts and science disciplines at sub-degree, degree and postgraduate degree levels. Specifically, the mission of the polytechnics is to, among other things, provide:

a) tertiary education in the fields of manufacturing, commerce, science, technology, applied social science, applied arts and any other field approved by the Minister of Education

b) opportunities for skills development, applied research and publication of research findings.

**Lessons Learnt in Upgrading the Polytechnics to Tertiary Status**

The development of the polytechnics as tertiary institutions was based on a strategy of elevation of technical institutes or by government pronouncement. These two approaches to the upgrading of the polytechnics did not specify any criteria or qualifying benchmarks (in terms of physical, human and academic resources required) for elevation to polytechnic status. Nor was any provision made for them to be mentored over a period of time by well-established tertiary institutions. The absence of a clear transformation strategy was one of the critical flaws of the polytechnic upgrading process, the ramifications of which are still evident in the polytechnic system today.

The history of polytechnic education in Ghana is a chequered one. During the first ten years of their upgrading, not a single year passed without one form of agitation or the other by the students, the teachers or the non-teaching staff. There were

demonstrations and boycott of lectures by students to back their demands for recognition of the Higher National Diploma, avenues for academic progression and appropriate placement of polytechnic graduates in the Public Service. The teachers on their part were unhappy about their conditions of service, often basing their discontent on salary disparities between them and their counterparts in the university who possess the same or similar academic qualifications. Much of the discontent and agitations witnessed in the polytechnics in the early years could be partially attributed to the absence of a clear mandate and a common understanding among all stakeholders of the role of the polytechnics in national development.

**Another fundamental system development failure in the polytechnic reform exercise was the absence of clarity in the mandate of the polytechnics compared with that of the universities.** Indeed, there are still some people at decision-making levels in the country today who do not understand the philosophy and orientation of polytechnic education. The polytechnics are often regarded as junior universities. Even some polytechnic students subscribe to this notion. It is this lack of understanding of the career-oriented nature of polytechnic studies that has been largely responsible for some of the staff and student agitations in the past.

Other difficulties faced by the polytechnics in the early years included poor funding, inexperienced management staff and a sluggish administrative system. Inadequate funding was a particularly serious problem for the polytechnics, which felt marginalized in the allocation of government resources vis-à-vis the universities. Throughout the 1990s, government expenditure per university student was twelve times the amount spent on a polytechnic student.

## Criteria for Conversion of the Polytechnics to Technical Universities

The proposed benchmarks, which are explained below, relate to three (3) key areas: i) institutional standing; ii) academic staff requirements; and iii)

evidence of collaboration with industry and employers in the delivery of study programmes.

i. **Institutional standing**

o    A polytechnic seeking to be granted technical university status should satisfy the existing norms, guidelines and standard requirements of NCTE and NAB for accreditation as a university, and

o The polytechnic should be already offering or be capable of offering a certain minimum number of accredited B-Tech degree programmes in science and technology based programmes.

The existing NAB institutional accreditation guidelines specify that to qualify for university status as a science and technology institution, the university should have a minimum of two (2) Faculties and two (2) Departments per Faculty. This benchmark is aligned with the internationally accepted definition of a "University". The committee endorses this requirement for qualification as a technical university.

The committee therefore recommends that for a polytechnic to be granted technical university status, it should be offering a minimum of four (4) BTech degree programmes in science and technology based disciplines.

On the issue of adequacy of teaching and learning infrastructure, many of the polytechnics have fairly well-equipped laboratories and workshops, although there is the need for some re-tooling and rehabilitation of existing training facilities. Consequently, the challenge of adequate academic infrastructure for the future technical universities can be satisfactorily addressed.

### Academic staff requirements

A key characteristic of a technical university is the requirement that the teachers should possess both academic and professional qualifications. In a technical university, possessing only an academic qualification (even a PhD) is not enough to qualify as a professor or teacher. Professional or industry experience is a key requirement. In Germany,

for example, it is mandatory for teachers in the Universities of Applied Sciences to have 3-5 years professional experience in the world of work.

The committee therefore recommends that any academic department seeking programme accreditation in the technical universities should be headed by at least a Senior Lecturer with a PhD and, preferably, with some industrial experience. In addition, the department must have at least 3 full-time Lecturers with relevant research master's degrees, at least one of whom must have industrial or work place experience.

**Collaboration with Industry**

In this regard, it should be required of the converted polytechnics as technical universities to provide evidence of training and partnership agreements or MOUs signed with collaborating industry partners.

In summary, the polytechnics would have to re-engineer themselves to become technical universities. This would entail the polytechnics emphasising staff development programmes to raise staff qualifications to university levels and developing capacity for curriculum engineering, management of internships, quality assurance, applied research and technology inter-change with industry. It is also important for the polytechnics to remain focused on career-focused programmes and not fall into the academic drift "trap" of offering traditional university type programmes.

**Mandate of the Converted Polytechnics as Technical Universities**

**The Committee recommends that the conversion of the polytechnics to technical universities should be accompanied by clear policies and regulations to prevent the new institutions from deviating from the desired objective of providing technical training and skills development of the kind that are not currently available in the traditional universities.**

*The Committee recommends that the converted polytechnics or future technical universities should be modelled along the lines of the Universities of Applied Sciences in Germany.*

My view point on all these will be in my power presentation.

**Applied Researach In Agricultural Technology Development And Dissemination: The Csir-Crops Research Institute Experience**

Manu-Aduening, J. A.
CSIR-Crops Research Institute, Kumasi

*Abstract*

Application of applied research in agriculture has achieved significant impact in most developed countries. However, much is yet to be realized in developing countries. Since its inception in 1964, the Crops Research Institute has made effective use of its applied research activities to develop and disseminated crops and crop production technologies which have made significant impact in Ghana's economy. The focus of this presentation is to review the applied research processes used by CRI, outcomes and achievements and the prospects for its continued use for crop production and processing in Ghana. The Institutes approach to developing agricultural technologies involves multi-disciplinary team of researchers working with stakeholders from planning and objective setting, choice of research strategies through to dissemination of technologies. This approach has produced remarkable results. Most of Institutes mandated crops such as maize, rice and cassava produced yields which are more than 30% of the yields attained two decades ago. There is also significant increase in general crop productivity in Ghana due to farmers' adoption of improved production practices. Post harvest processors have also use various technologies on processing to add value to most of the crops thus increasing their acceptance to consumers and other end-users. A few challenges such as limited funding, poor remuneration for researchers and high attrition rate have been encountered but there are brighter prospects for continued use of applied research to sustain crop production and processing industry in Ghana.

*Introduction*

Applied research in agriculture has produced significant impact on food production and raw materials for industries in both developed and developing countries over the past centuries. The impact is very high in developed countries compared to developing countries.

Applied research in agriculture started more than 200 years ago in the developed countries. However, in Africa it started in the late 19th century when the continent was colonized. During this period the focus of research was on development of low-cost supply of raw materials from indigenous or tropical crops (Simmonds, 1979). By 1900, a number of botanical gardens, model farms and experimental farms were established in different parts of Africa. One of such stations established for plant breeding was in Amani-Tanzania (1890). In West Africa, restructuring of some existing agencies into regional institutions to carry out research in agriculture started in mid-1900 (Azania, 1989). The Cocoa Research Station of Gold Coast (Ghana) became the West Africa Cocoa Research Institute in 1944. The Rice Experimental Station in Sierra Leone was transformed into the West Africa Rice Research Station in 1949 and later the West Africa Rice Research Institute. The Oil Palm Research Station in Nigeria became the West Africa Institute for Oil Palm Research in 1951. All three institutions were part of West Africa Inter-Territorial Research Organization (WAIRO), an umbrella body for the regional research activities in British West Africa. Activities in other crops started in Ghana following the formation of Crops Research Institute (CRI) under the Ghana Academy of Sciences and later the Council for Scientific and Industrial Research in 1964 (CRI, 1970).

Since its inception, the Crops Research Institute has focused its research activities on developing

and disseminating appropriate technologies for high yields and sustainable food and industrial crops production with a view to becoming a Centre of Excellence for innovative and quality agricultural research for development. The Institute has the mandate to work on the following crops, Cereals (maize and rice), legumes and oil seeds (cowpea, soybean, groundnut and bambara groundnut), Roots and tubers (cassava, yam, sweetpotato and cocoyam), Horticultural crops (plantain and banana, tropical fruits- citrus, mango, avocado pear, pineapple, cashew and pawpaw; vegetables-pepper, garden eggs tomato, onion and leafy vegetables; industrial crops- rubber, sugar cane and bast fibre)

In the early days of the Institute, the research activities focused on developing technologies using the classical model or the Top-down approach where research objectives were set based on special issues of national interest (CRI, 1970). In this approach, most researches were carried out at the stations of the Institutes (on-station research) thus the target clients' inputs were minimal until the late 1970's and early 1980's when the Ghana Grains Development Project (GGDP) came in to support maize and legumes research. This project brought three institutions (CRI, Grains Development Board and Ministry of Food and Agriculture (MoFA) Department involved in crop production and dissemination) together to complement each other in technology development and dissemination.

The period of GGDP (1979 to 1990) and post GGDP era had seen tremendous technology development and dissemination probably because of the integrated approaches used. Most of the technologies were developed with active participation of different stakeholders and the products from such technologies were relevant to their needs. Adoption of improved maize and cowpea varieties developed by the project

increased and has since been very high (Ragasa *et al.*, 2013).

Dissemination of improved technologies from research activities has been going on with collaboration from Ministry of Food and Agriculture and other interested agencies over the last three decades. Several approaches such as train and visit, on-farm research, on-farm demonstrations, farmer field schools, farmer field fora, research-extension-farmer linkage committees, innovation platforms and use of print and electronic media have been used to disseminate technologies; all with a view to increasing clients' adoption of new technologies for increased productivity. Success rates for such processes have been reported in Ghana (Morris *et al.*, 1998), however, the expected level of success is yet to be achieved due to various challenges including human and financial resources, technical competence and motivation for staff. The focus of this paper is to review the applied research processes used by CRI, outcomes and achievements from such processes and the prospects for continued use of applied research for increased crop production for food and industrial uses in Ghana.

***Research Facilities and Procedures Used***
*Research facilities*

The Institute conducts its research activities (on-station and on-farm) at its head office at Fumesua and other outstations located in the different agro ecological zones in southern Ghana (Forest, Forest-Savannah Transition and Coastal Savannah). The outstations were established to serve as multi-locational testing sites for technologies developed for clients and make appropriate recommendations based on specific locations.

Most of these stations are equipped with irrigation facilities for all year-round field work and modern automatic weather equipment to collect data to support research data obtained at

the different locations. The Institute's head office at Fumesua has a modern Biotechnology laboratory, Food science laboratories as well as screen houses where controlled experiments are carried out.

*Organizational structure of research programme*

The Research Institute operates on crop commodity bases, however, the research activities are led by relevant technical programmes such as Plant Breeding, Resource and Crop Management, Crop Protection, Biotechnology, Biochemistry, Post Harvest and Food Science, Socio-Economics, Biometry, Information Technology and Technology Transfer. There are active links and collaboration among the different disciplines, each providing support to the other and working concurrently in multidisciplinary teams to address research issues.

Structure of Research Programmes at CSIR-Crops Research Institute
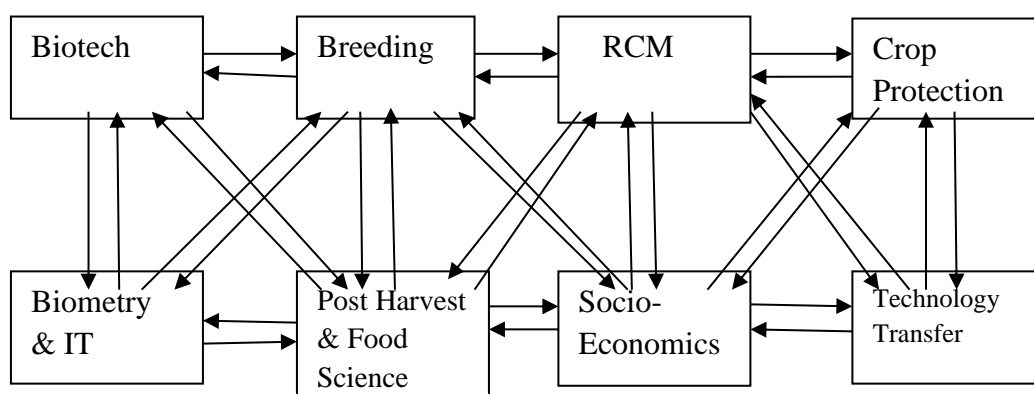


*Research planning and objective setting*

The applied research procedures adopted by Crops Research Institute, involve series of activities spanning from diagnostic stages through planning, experimentation, assessment, recommendation and dissemination of technologies developed. These stages are followed through concurrently either annually or anytime when new issues of research or projects are started.

*a. diagnostic (constraints identification)*

This stage involves collecting and analyzing researchable challenges which forms the bases for the research to be conducted. This stage usually includes a review of secondary data, interviews with clients, field observations and formal surveys. The purpose of the diagnostics is to gather information to describe the basic features of the research which may include identifying constraints that limit agricultural productivity and set the stage for designing possible solutions. This stage usually uses the expertise of different stakeholders including researchers, farmers, extension staff and other key partners involved in the commodity or the research value chain.

*b. Planning and sharing of responsibilities*

This stage focuses on analyzing and prioritizing the different constraints identified, examination of options for addressing constraints, assessment of available resources (human, financial and equipment) and timeframe for delivery of output as well as sharing of responsibilities for achieving the desired outputs.

*c. Experimentation*

The type of experiment used to provide solutions often depends on the nature of the constraints, resources available and level of knowledge required for effective and efficient solution of the constraints being addressed. Usually the lead experts often used at this stage may involve one or more of the following disciplines, Plant Breeding, Biotechnology, Agronomy, Plant protection, Post harvest/Biochemistry and Socio-economic. In most cases the expertise and opinion of different end-users are also sought.

*Changing trends in research experimentation and activities*

Previously, most of the experimentations were carried out sequentially and independently by different researchers. This approach provided the desired results but had certain limitations such as delayed delivery of results because one activity must be completed before another is started. There were also issues of separate recommendations which in some cases were conflicting.

Currently, different experts and disciplines in the value chain work together under innovations, including participatory research approaches and Integrated Agricultural Research for Development (IAR4D), using platform approaches. These innovations have been used to achieve better results within short periods.

*d. Assessment, data collection and analyses*

Field assessments are often carried out by different experts involved in the experimentation. This includes researchers and users of the results. Each assessor evaluates and collects data using predetermined criteria. In situations where clients' views are required for recommendations to be made, the clients are guided to answer certain questions or their views

are collected using participatory appraisal approaches.

Data collected from research activities by different assessors are collated by the various team leaders and analyzed using appropriate statistical tools often guided by a statistician or biometrician.

*e. Recommendation and dissemination of technologies*

When researchers are confident that they have enough and credible information, they formulate recommendations for use by the target clients.

Dissemination of technologies has been carried out by researchers, communication experts, extension staff and NGOs involved in the various agricultural value chains. The focus of current dissemination of improved technologies has centered around achieving active participation of different stakeholders, enhancement of stakeholder to stakeholder dissemination and encouragement of shared learning on use of new innovations and technologies.

*Results and Achievements*

Over the past fifty years, the Crops Research Institute, through its applied research systems has achieved significant results by developing and disseminating superior crop varieties which are high yielding, tolerant to biotic and abiotic stresses and used for different purposes including food and industrial products. The crop improvement programmes which use expertise in plant breeding, biotechnology and plant protection have released improved varieties of crops for farmers and different end-users (Table 1).

Table 1. Achievement of crop improvement through crop varieties released

| Crops | No of varieties released | Year of released | Yield potential (T/ha) | Special attribute |
|---|---|---|---|---|
| Maize | 30 | 1983-2012 | 3.0-7.9 | High yields, Extra early, drought tolerant, QPM, pro-Vitamin A, MSV resistance |
| Cowpea | 13 | 1983-2007 | 2.5-3.2 | High yields, resistance to pests and diseases |
| Soybean | 4 | 1993 | 2.5-3.0 | High yields, resistance to pests and diseases |
| Groundnut | 12 | 2006-2012 | 2.4-2.7 | High yields, high unsaturated fatty acids, rossette and *cercospera* resistance |
| Rice | 7 | 1997-2010 | 6-8 | High yield, long grain |
| Cassava | 17 | 1993-2015 | 25-45 | High yields, resistance to diseases, HQCF, hi-starch |
| Sweetpotato | 12 | 1995-2012 | 17-35 | High starch and Beta-Carotene |
| Yam | 3 | 2005 | 30-50 | High yields, suitable for export |
| Cocoyam | 3 | 2012 | 5.7-8.0 | High yield, tolerant to diseases |
| Plantain and banana | 2 | 1999 | 35-40 | High yields, tolerance to diseases, high minerals and micro-nutrients |
| Pepper | 2 | 2005 | 3.0-3.5 | High yield, spicy |

Production for most of these crops increased by more than 20% over the last 20 years when farmers started adopting superior varieties developed and disseminated by CRI. Production of some important crops like maize increased from 2.4 T/ha in 1993 to 5.2 T/ha in 2013, paddy rice increased from 2.7 T/ha to 3.5 T/ha and cassava from 7 T/h to 12 T/ha during the same period (FAOSTATS, 2014). An increase of more than 30% (Table 2, Figs 1 & 2).

Table 2. Change in production of some important crops in Ghana over the last 20 years

| Crop | Production in 1993 (Tons) | Area cultivated in 1993 (Ha) | Production in 2013 (Tons) | Area cultivated in 2013 (Ha) | Changes in production area (%) | % change in production (20yrs) |
|---|---|---|---|---|---|---|
| Maize | 15,092 | 636,7000 | 17,240 | 1,023,459 | 60.7 | 14.0 |
| Rice | 20,389 | 77,200 | 26,378 | 215,905 | 179.7 | 29.4 |

| Cassava | 115,776 | 531,800 | 167,241 | 870,000 | 63.6 | 44.5 |
|---------|---------|---------|---------|---------|------|------|
| Ground nut | 8,750 | 160,000 | 12,428 | 328,940 | 105.6 | 42.0 |
| Yam | 131,606 | 206,700 | 154,419 | 430,000 | 108.0 | 17.3 |

*Source: FAOSTATS, 2014*

CRI's effort at ensuring national food security is evident in crops like cassava, maize and plantain. Production of cassava has gone up significantly and currently its use as industrial raw material for starch base products such as alcohol, glue and pharmaceutical products is being exploited. The plantain program has focused its activities on improving crop practices and disseminating *sigatoka*-tolerant planting materials (FHIA-21) for production since 2000. This saw plantain production increasing significantly from 8 to 11 T/ha (>35% increase) from 2003 to 2009.

Applied technologies in rice production in the inland valleys have significantly boosted the yields in these ecologies. The Sawah technology not only increase yields but also sustainably conserves the environment and manages water.

The remarkable increase in production of most arable crops, as a result of applied research by CRI and allied research institutions contributed to the 40% of Ghana's Gross Domestic Product (GDP), with cassava alone contributing 22% of the Agricultural Gross Domestic Products (AGDP), (Otoo, 1998; Dapaah, 1996)). The high increases in arable crop production over the past two decades have also been partly attributed to producers' adoption of improved production technologies such as techniques for selecting suitable sites, good land preparation, rapid production of healthy planting materials, appropriate plant densities, timely planting, pests and diseases control (including weeds), fertilizer use, timely harvesting and good post harvest handling of crops recommended by CRI.

Pests and diseases contribute significantly to reduce crops yields and quality of products. Crops Research Institute, through its active programme in plant pathology has contributed in controlling some important crop pests and diseases including cassava and mango mealy bugs, Siam weed (Chromolaena odorata) and spear grass.
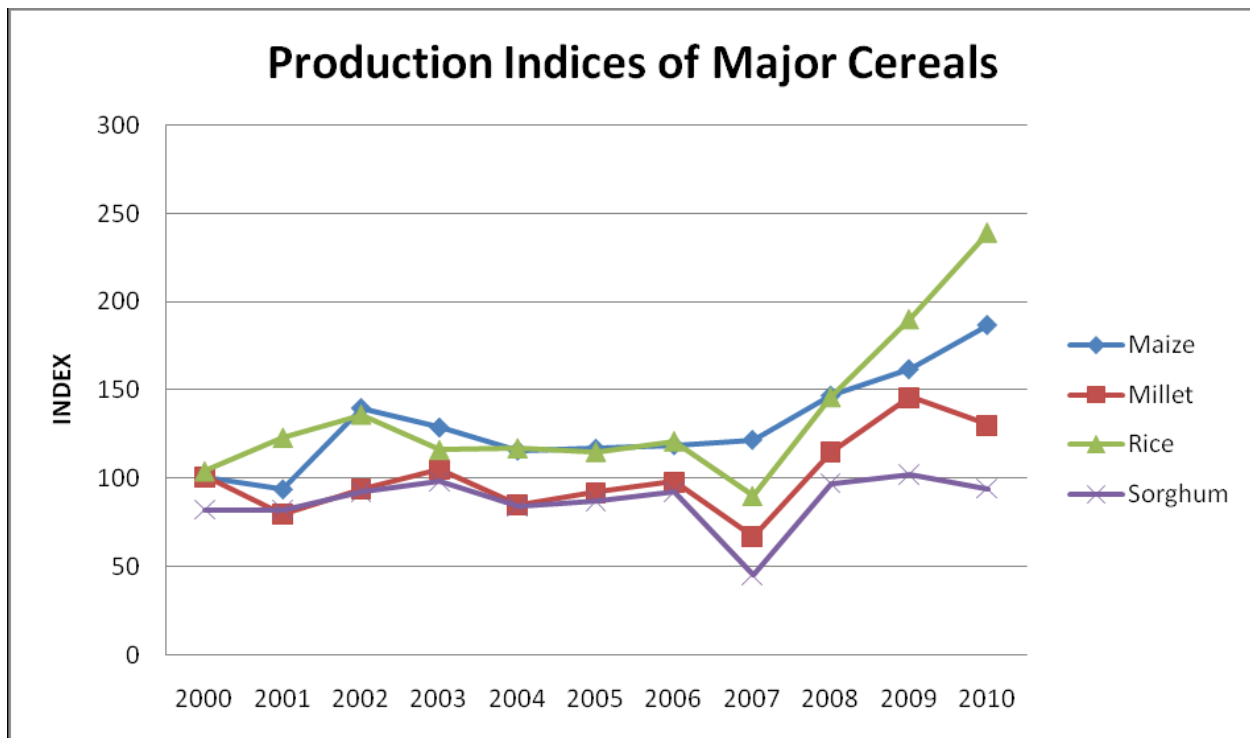
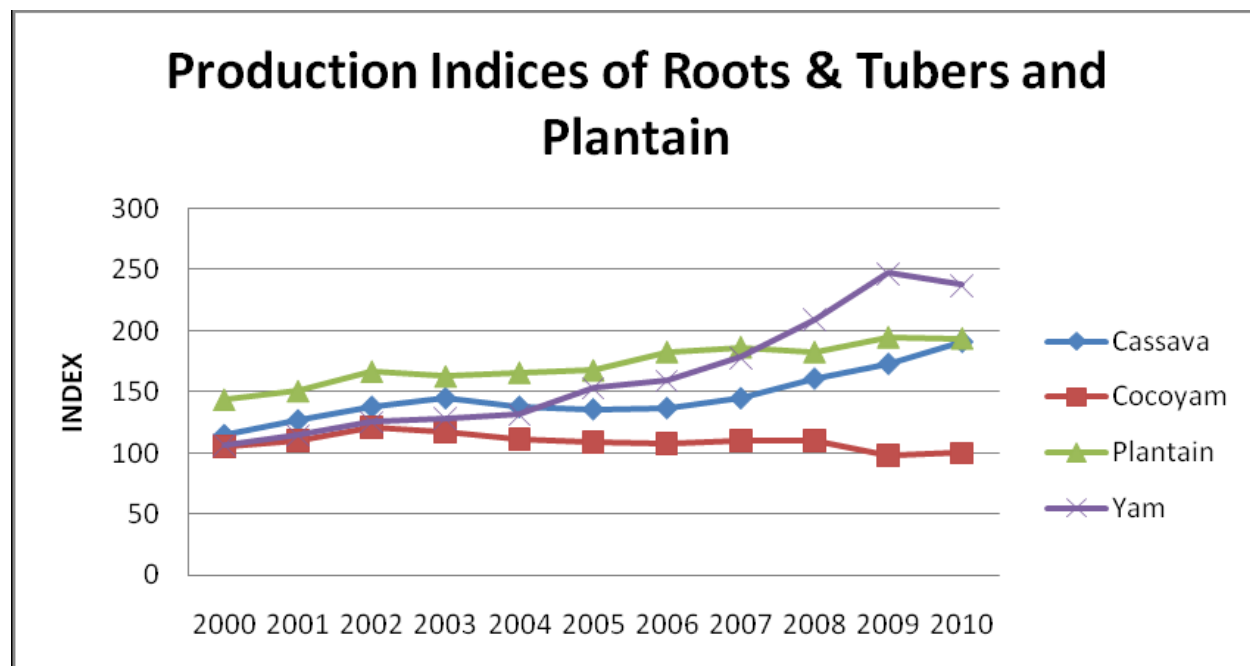Figure 1. Production indices of major cereals grown in Ghana (2000-2010)



Figure 2. Production indices of roots and tubers and plantain (2000-2010)

Biotech has supported plant breeding and provided additional tools in four main areas (i.e. molecular characterization and finger printing, marker assisted breeding, grafting and tissue culture and sources of genetic variation). Molecular characterization and finger printing of crop varieties have been used to clearly identify and characterize different crop varieties. Whilst Marker-assisted breeding has provided remarkable improvement in the efficiency with which breeders can select plants with desirable combinations of genes. These tools have brought tremendous relief to most breeding programmes. In cassava breeding, the duration of variety development has been reduced from 12 to 5 years with very little doubt on crop identification and quality (Trevor, *et al.*, 2002; Manu-Aduening *et al.*, 2006).

Grafting of tissues from two different varieties of a plant species has been used by researchers at CRI since its inception in woody tree and vine crops such as citrus, mangoes, avocado pears and ornamental plants. Grafting a scion or bud from one variety onto a rootstock from a different variety is commonly used to enhance the disease resistance, productivity, and growth habit of these perennial crops. Tissue culture ha s also been used in crop improvement for mass production of clean planting materials for vegetatively propagated crops which have low multiplication rate, thus enhancing the availability of planting materials for increased production

The Postharvest and Food Science programme has developed technologies that facilitate handling of perishable produce (e.g. tomatoes) and micro-scale agro-processing of various crops by adapting 'zero-energy' storage and processing technologies (requiring very low capital input and no electricity) for crop shelf-life extension and value addition. Other technologies disseminated include, evaporative cooling of fresh produce, low-cost solar drying (to preserve non-durable produce), farm-level curing of yams and promotion of low-cost barn models for extended storage. The Team's product development activities also served to enhance adoption of the Institute's released crop varieties by providing product diversity, utilization training and awareness creation of potential contribution of CSIR-CRI's improved varieties to livelihood enhancement and nutritional improvement.

The Socio-economic team has provided immense support by providing baseline data, market information and other vital information for other scientists to use as justification for the various applied researches conducted at the institute. Their support to research has led to the provision of data showing the significant contribution of CRI's applied research to the economic development of Ghana.

*Impact of some research findings*

Through its research activities the Institute made a lot of impact both in the livelihoods of clients and many Ghanaians (both rural and urban populace) who depend on agriculture for their livelihoods. For example, Dankyi *et al*, 2006, reported that, the annual social benefit from maize research in Ghana increased from $4.8 million in 1979 to $84 million in 2005 whiles the internal rate of return for maize research and extension activities from 1979 to 2005 was 79% and the internal rate of return of cowpea research and extension activities from 1979 to 2005 was 58%. As at 2004, over 70% of Ghanaian farmers using CRI improved cowpea varieties and agronomic practices increased by 10 folds. These findings give credence to CRI's contribution to improving food security, wealth creation and improved livelihoods through its applied research and technology dissemination activities.

*Contribution to Ghana's economy through some donor funded projects*

The significant success achieved by CRI in its contribution to Ghana's agricultural economy is linked to external donor support. The links with donor funded projects increased considerably during the last three decades. Almost all sectors and divisions within CRI have received funding which helped in capacity building (both human and material). Most researchers had training in different fields and had the opportunity to upgrade their knowledge and skills for efficient delivery in the research programmes. Such assets have been the greatest motivation for staff of CRI. Most of the Institute's facilities including a modern biotechnology laboratory, irrigation, meteorology and field equipments were obtained from these supports.

*Some challenges in CRI's applied research activities*

Whilst celebrating the immense contribution of CRI's applied research to the Ghanaian economy, it is also important to acknowledge that several challenges have been encountered though these have not swamped the efforts of researchers. The following are some key challenged encountered.

- Market consideration verses research focus and objectives

- Funding of market oriented research

- Availability of human resources

- Poor remuneration and conditions of service resulting in high attrition of staff

- Inadequate research facilities

- Low coordination/linkage among researchers and stakeholders

- Poor incentive for researchers

- Encroachment of research lands

- Lack of funding for basic research

*Lessons learnt and future prospects*

Important lessons have been learnt over the past decades. Most of them have been used to improve upon researchers outputs while others have served as opportunities for researchers to seek funding (local and foreign) and international collaboration for higher and better research activities. One important lesson worth mentioning is integration of multi-disciplinary approach to applied research. This approach has greatly changed the rate of delivery, increased cohesion among researchers and credibility of research outputs.

Some key questions bothering success of applied research in agriculture ought to be carefully looked at to help improve the entire process. They include;

a. Who sets research agenda? Researcher, client, government or donor?

b. Should the process be demand led (market, etc,) or social intervention?

c. Can the private sector be actively involved in applied agricultural research?

d. Is donor dependency for research fund sustainable for Ghana?

In spite of these questions, the prospects for applied research in agriculture are very bright.

- There is high demand for high yielding varieties

- Diverse markets for most crops especially crops like cassava and sweetpotato for

brewery, bakery, lumber (glue), textile and pharmaceutical industries

- High demand for local food uses and food processing

- High export demand for processed products to neighboring countries, e.g. Gari, starch

and High Quality Cassava Flour (HQCF)

- Increased avenue for job creation and improved livelihood

*Conclusions*

The applied research carried out by CRI over the past four decades has achieved significant results and contributed immensely to increase food production and improved livelihoods for many (rural and urban) who depend on agriculture and its products. Yields of most crops have increased by more than 30% and value added to most of them thus increasing their acceptance to local and export markets. There is increased co-ordination and collaboration among researchers which have resulted in efficiency in delivery of outputs, however, technology dissemination has been inefficient, resulting in many good agricultural technologies remaining unused by clients to improve productivity and income. There are bright prospects and relevance of applied research in agriculture in Ghana since crop production, processing and value addition have increased and contributed to the Gross Domestic Product of Ghana.

## References

Azania, XXIV (1989). History of African Agricultural Technology and Field Systems by John
        Sutton Review by: James C. McCann. The Journal of African History Vol. 32, No. 3
        (1991), pp. 507-513

Crops Research Institute (CRI), (1970). Annual Report, CRI, Kumasi, Ghana

Dapaah, S.K., (1996). The way forward for accelerated growth and development. A paper
        presented to the government of Ghana on behalf of the Ministry of Food and
        Agriculture.6 pp

FAOSTAT, (2014), http://faostat.fao.org.

Manu-Aduening, J.A. Lamboll, R.I. Ampong Mensah, G. Lamptey, J.N. Moses, E., A.A. Dankyi
        & Gibson, R.W. (2006). Development of superior cassava cultivars in Ghana by farmers
        and scientists: The process adopted, outcomes and contributions and changed
        roles of different stakeholders. *Euphytica* 150: 47-61.

Morris, M., R. Tripp, and A. Dankyi. (1998). "Adoption and Impact of Improved Maize
        Production Technologies. A Case Study of the Ghana Grains Development Project."
        Economics Program Paper 99-01. Mexico, D.F.: International Maize and Wheat
        Improvement Center (CIMMYT).

MOFA (Ministry of Food and Agriculture). (2011a). "Agriculture in Ghana: Facts and Figures
        (2010)." Statistics, Research, and Information Directorate. Accra, Ghana.

Otoo, J. A., (1998). Centre Commissioned External Review of IITA. The Root and Tuber Crop
        Improvement Programme of the Crops Research Institute, CSIR, Kumasi, Ghana.

Ragasa, C., Dankyi, A., Acheampong, P., Wiredu, A.N. Chapoto, A., Asamoah, M. and Tripp, R. (2013). Patterns of adoption of improved maize in Ghana. Ghana strategy support program. IFPRI, Working paper 36.

Trevor, V.S., Bruce, R.T and Kent, J.B. (2002). Biotechnology provides new tools for plant breeding. Agricultural Biotechnology in California, Series 8043

Simmond, N. W., (1979). Principles of crop improvement. Longman Group Ltd, London, U.K.

# Biotechnology Application To Crop Improvement And Production: A Tool For National Development

AUTHOR: Dr. (Mrs.) Marian D. Quain

## 1. INTRODUCTION

According to projections by the United Nations, the world's population will increase by 25% to 7.5 billion by 2020. The estimates have it that the world population grows averagely by 73 million people annually, and 97% of the growth is in the developing countries. The earth is pressured to provide food, feed, fuel and fiber for the world's growing population on the same surface area. All these essentials are produced from plants, which compete with human and urbanization for space. The need to enhance crop productivity, cannot therefore be over emphasized. For this to be possible, a lot of factors come into play and these include; human resource, seed, land, water, political climate, weather, good human health and technology.

Globally Africa houses a greater proportion on the annual population growth, however most countries on the continent are referred to as poor developing countries. Catering for the growing population is paramount and this can be achieved through increased crop productivity in agriculture. It is worthy to note that increased crop productivity is essential for sub-Saharan Africa's growth and for achieving the MDG of halving poverty by 2015 (which most countries have defaulted). The agriculture sector offers employment for approximately 65% of Africa's labor force and accounts for 32 percent of gross domestic product. Although performance in the agricultural sector has improved since 2000, growth is not yet fast enough. Agricultural GDP growth in sub Saharan Africa has accelerated from 2.3 percent per year in the 1980s to 3.8 percent per year from 2000 to 2005. Growth has been based on expansion of area of cultivation in the face of scarcity of land. Farm yields are among the lowest worldwide, there is therefore the need to have high and sustainable crop production, which can be attained by facilitating agricultural markets and trade, improving agricultural productivity, investing in public

infrastructure for agricultural, reducing rural vulnerability and insecurity, and improving agricultural policy and institutions. Africa is endowed with a rich diversity of natural resources and foods crops. However, Africa is routinely referred to as the needy continent and continually the World over has to come to our aid with conventions etc. What is actually lacking is sustainable use of our resources, development and adoption of technologies in this current global village with emerging technologies, in the face of growing populations, harsh environmental conditions and climate change. Technological development is a key factor in raising income levels and improving livelihoods of the people. Technological methods applied in crop research have been towards the improvement of crops and integrated crop management practices. The development of crop improvement methods over the years have gone through several advancements and the tools in biotechnology have contributed immensely to the various advancements and research efforts.

Biotechnology is the field of science that uses living organisms or genetic material from living organisms to provide new products for agricultural, industrial, and medical uses. This science has existed since the ancient times and a process such as fermentation for preparation of corn dough for kenkey, production of Pito and palm wine, uses micro organisms to facilitate the process. Yeast used for flour rising in bread preparation also employs living organism to achieve a product (biotechnology). Over the years, there have been consistent advancements in the field of biotechnology and it is currently referred to as Modern Biotechnology, where genes that are responsible for particular traits are manipulated in the laboratory under controlled

environment to develop products or impart specific capabilities to organisms. Several fields of science are related either directly or culture, which is a fundamental tool applied in the manipulation of genes, molecular markers; and bioinformatics; recombinant DNA (rDNA) technology; expression profiling; systems biology; proteomics; molecular diagnostics; mutation breeding and genetic engineering as applied to improve yields and quality of mostly high value crops, livestock and other farming processes as well as vaccine production. In the advanced countries, Biotechnology tools are well advanced and it is known to be progressing faster than computer technology, however, in developing countries the techniques are just at developmental and application stages.

Ghana is a developing country in West Africa, which is working towards the attainment of middle income economy. The Council for Scientific and Industrial Research-Crops Research Institute (CSIR-CRI) in Ghana, one of the leading national agriculture research organizations conducts research to serve the resource poor farmer in Ghana. The CSIR-CRI started employing biotechnology research tools in 1996. The facility has tissue culture, and molecular biology laboratories. Tissue culture has contributed to crop introduction and release in Ghana. Applications of Biotechnology related tools in agriculture have contributed to the production and supply of improved quality seed and planting material to farmers. In this direction, biotechnology and related sciences are used to:

- Rapidly multiply vegetatively propagated crops (Tissue Culture),
- Production of true to type planting materials
- Plant diseases detection,
- Elimination of diseases associated with planting materials
- Crop protection by means of biological control
- Molecular fingerprinting to endorse crop varietal identity and purity.

## 2.1 Tissue culture
Tissue culture is the art of growing plant parts

indirectly to Modern biotechnology, and these include tissue

genomics

in a designed medium under controlled and sterile environment in glass or plastic containers. The small plant seedlings generated are gradually exposed to the normal environment through the process called acclimatization. Tissue culture process, which is also referred to as micropropagation, results in the production of healthy disease free planting materials, where, bacteria, Fungi and viruses are eliminated. This process leads to seedling with enhance capacity to produce higher yields as deficiencies caused by diseases are eliminated, however it must be noted that the clean seedling when exposed to disease and pathogens have the tendency to get re-infected as no gene conferring resistance etc, are introduced. Micropropagation has been used in several crops including fruit trees (e.g. banana, date palm), roots and tubers (e.g. potato, cassava), vegetables (e.g. strawberry, asparagus), and ornamentals (e.g. roses, orchids). Many companies and institutions worldwide have invested or specialized in this activity, to provide farmers and growers with high quality and healthy planting material.

Some of the procedures under tissue culture include protoplast cultures and hybridization, anther cultures, embryo rescue and somatic embryogenesis. Somatic embryogenesis is a procedure where a plant or embryo is derived from a single non-gamete (somatic) cell or group of somatic cells can be employed to improve and propagate genetically uniform plant material, eliminate viruses and produce clean planting materials. Somatic embryogenesis offers an efficient *in vitro* tool for multiplication and also a basic tool for transgenics since it offers a single cell origin, hence there is low frequency of chimeras. It is also used in the system where somatic embryo formed is encapsulated in silica gel to form an "artificial seeds" which is treated as seed, and planted to generate a whole plant. In Ghana

and at the CSIR, this system has been developed for yam to enhance productivity in the crop (Quain and Egnin, 2014). To produce clean planting material of our vegetatively propagated crops, protocols have been optimized and are currently being used routine for microprogation of plants (Quain et al 2010a) cocoyam (Quain et al., 2010b), sweetpotato, yam, taro and cassava.

Virus elimination in planting materials of vegetatively propagated crops by meristem culture, heat and or chemical therapy (a tissue culture procedure), is fundamental. This procedure is however, not being used routinely in the production of local crops such as yam, cassava, plantain, cocoyam and sweetpotato, all of which are vegetatively propagated. Currently the existing seed systems use apparently clean planting materials from generation to generation and this provides the likelihood of transmitting viruses and other pathognes from generation to generation. It is therefore not surprising that reports has it that there is the prevalence of badnaviruses in West African yams (*Dioscorea cayenensis-rotundata*) and evidence of endogenous pararetrovirus sequences in their genomes (Seal et al., 2014). Similarly, the banana streak virus is also reported to be integrated into the genome of some Musa varieties (Gayral et al., 2009). These reports can be devastating if our yam and Musa crops are to break down due to the presence of the viruses in their genomes since these crops have a narrow genetic base. Current research efforts at the CSIR-CRI meristem cultures are being used in the laboratory to produce clean pre-basic planting material for all the vegetatively propagated crops using meristem cultures and thermotherapy. The norm is that a meristem (the apical part of a stem) is normally free from diseases. If a meristemic cells are taken from a contaminated plant and is grown *in vitro* under appropriate conditions (preferably elevated temperature of 40°C), it will regenerate a plantlet that will be disease-free. This plant can then be propagated either *in vitro*, or *in vivo* under strictly controlled conditions, to ensure production of healthy planting material. This technique has been widely used for decades on many vegetatively propagated crops and is still used to regenerate some diseased cultivars. Our research findings have proven that the used of cleaned planting materials result in a yield advantage of 15 – 30 percent (Quain and Dzomeku, 2013; Otoo and Quain, 2001)

## 2.2 Molecular Marker fingerprinting

The genetic progress in improving crop varieties has been achieved based on phenotypic selection, which depends on the heritability of the trait. Traits with low heritability are difficult to improve. The use of molecular markers can be fast, reliable, and reproducible method of crop improvement. Selection of varieties with suitable traits that can be used in breeding program to overcome the existing cultivars with low yields, disease resistance and dormancy will minimize the post harvest losses and improve the quality of stored produce. The advent of molecular markers, genome studies, offers avenues for circumventing breeding obstacles. Molecular markers do not require gene expression and are not affected by the environment. Marker assisted selection has proven to increase selection efficiency, especially for traits with low heritability. This techniques can be used to monitor genetic integrity of germplasm during manipulations, as well as trace crop varieties based on their genomic information. Some research output at the CSIR-CRI laboratories include;

Use of simple sequence repeat (SSR) markers to establish genetic relationships among cassava cultivars released by different research groups in Ghana (Twumasi et al., 2014) this study revealed a strong genetic diversity within populations of released cassava varieties, which suggested a low rate of inter population gene flow among the individuals constituting the populations. This high genetic variability among the cultivars provide valuable genetic resources to support any future breeding program aimed at establishing cassava varieties for domestic and industrial use. In

another development, a study on the Genetic relationships between some released and elite Ghanaian cassava cultivars based on distance matrices concluded genetic distances between released cassava varieties in Ghana and indicated that could be used effectively in breeding programs in Ghana.

A study was conducted on soybean to explore the genetic diversity in accessions from three countries; Ghana, Nigeria and Brazil using Microsatellite molecular markers for simple sequence repeats (SSR). They used 20 soybean SSR primers which was able to detect genetic variability among soybean germplasm used in the study. It was concluded that the germplasm are good materials from which suitable parental lines could be selected for hybridization in a breeding programme. The use of principal component analysis (PCA) revealed that days to maturity, seeds per pod and plant height were important traits for estimating relationship among accessions from the respective countries; an indication that the germplasm from these countries were unique. Both the dendogram and the PCA biplot showed a clear picture of complimentarily from which they could be used to select suitable parental lines for crosses to be initiated (Appiah-Kubi et al., 2014). Fingerprinting of yam and cassava germplasm holdings in Ghana facilitated elimination of duplicates and generated clusters to be used for conservation of core germplasm using the limited resource (Asibuo et al., 2011; Prempeh et. al, 2011).

## 2.3. USE OF BIOTECHNOLOGY IN PLANT BREEDING

The concept of using molecular markers to identify specific regions of the genome is now well established. Molecular markers in plant systems have been found very useful in conventional breeding by carrying out indirect selection through molecular markers linked to the traits of interest. Molecular markers have been used for both simple and quantitative trait loci (QTL) because the environment does not influence these markers and can be detected at all stages of plant growth.

Crop improvement is the exploitation of genetic variability, followed by several generations of selection. Breeders have always used the most modern technologies available to them. This has permitted them to make considerable progress during the last twenty years, thanks in particular to the development of biotechnology.

## 2.4 Molecular Marker-assisted breeding

Recent increasing knowledge in molecular genetics has allowed the characterization of a number of molecular events in crops, these include whole genome sequencing and mapping to establish molecular marker systems that facilitates marker-assisted breeding, genetic diversity studies, and creation of polymorphism that allow a whole range of analyses from chromosome mapping through to population or clone level. Hence, the need to explore the genome of all our crops cannot be over emphasized. Markers may be either phenotypic or genotypic, biochemical. Some of, the DNA markers used in breeding programmes include Random Amplified Polymorphic DNA (RAPD), Amplified Fragment Length Polymorphism (AFLP), microsatellites, and Expressed Sequence Tags (ESTs), SSR, Single Nucleotide Polymorphism (SNPs), DArT, and RNA Sequencing. The cost, efficiency and advantages of the listed marker systems vary and the research objective guides the selection of appropriate system, although some of them are currently outmoded, however, in developing countries, the outmoded techniques are still being explore to facilitate unearthing and mining genes and traits of interest in germplasm.

In crop breeding and variety development, these tools allow acceleration of the selection process, there is greater precision in the developing a variety and the number of years used in varietal development is reduced from 6 – 10 years to 2 – 4 years.

The broad interventions captured under breeding are:

- Enhanced knowledge of breeding material and

systems, such as better understanding and more effective breeding of Quantitative Trait Loci (QTL);

- Rapid introgression or backcross breeding of simple characters, as the number of back-crosses required can be reduced drastically if there are markers for the character to be introduced and for the genetic background of the recurrent parent;

- Early character selection, which is important for genes that cannot be detected at an early development stage, such as high lysine and tryptophan genes in maize; and

- New goals not possible through traditional breeding, including pyramiding of disease resistance genes with indistinguishable phenotypes.

At the CSIR – CRI, molecular characterization of solanum species using EST-SSRs and analysis of their zinc and iron contents, population studies suggest gradual homogeneity of these accessions due to the high gene flow and outcrossing rate over time, revealing zinc and iron contents of solanum (Oppong et al., 2014). Molecular markers have facilitated the Introgression of Cassava Mosaic Disease resistance into farmer preferred cassava genotypes in Ghana, in the development of varieties with resistance to disease that reduces yields (Parkes et al., 2013). Also, evaluation of cassava F1 genotypes and progenitors resistant to Cassava Mosaic Disease (CMD) for the putative presence of the CMD2 resistant gene using molecular markers has been carried out (Parkes et al., 2009), and molecular breeding has been used to fast-track release of Delayed PPD and Disease Resistant Cassava in Ghana (Parkes et al., 2007).

### 2.5 Disease Diagnosis

Effective crop management involves the early and accurate diagnosis of plant disease. Early introduction of effective control measures in plant development can facilitate plant diseases management. Reliance on symptoms is usually not satisfactory in this regard. This is because the disease may be well underway when symptoms first appear, and symptom expression can be highly variable. Some Immunological and nucleic-acid hybridization-based methods available for pathogen detection in crop systems are listed below:

Immunoassay Technology

Enzyme Linked Immunoabsorbent Assay (ELISA)

Colloidal Gold

Immunofluorescence Assay (IFA)

Radio Immunoassy (RIA)

- Nucleic – Acid hybridization – Based Pathogen detection

Nucleic Acid-Based Detection Technologies

Dot – Blot Assay

Nonradioactive Labels

Restriction Fragment Length Polymorphisms (RFLPS)

Nucleic Acid Probes

Uncloned Probes

Synthetic Probes

Cloned Probes and RFLPS

Viruses and Viroids

Mycoplasma – like organisms and bacteria

Fungi

Nematode

Molecular biology tools that have been explored so far in our CSIR-CRI Laboratory include the application of molecular markers to screen for occurrence of disease in crops. This is being applied for African Cassava Mosaic Virus (ACMV) in cassava, Tomato Yellow Leaf Curl Virus (TYLCV) and Root Knot diseases in tomatoes (Osei et al 2012), yellow mottle virus in rice and Sweet Potato Virus Disease (SPVD) in sweetpotato is still at the developmental stages (Abrokwah et al 2013). In a recent study on cassava, disease observations in the field were confirmed with laboratory diagnostics using the polymerase chain reaction assay. African cassava mosaic virus (ACMV) and East African cassava mosaic virus were detected on all the cultivars either as single infections or as mixtures. The detection of EACMV on cassava at Fumesua and Ejura is the first to be reported in Ashanti region in Ghana. This study recommended that, with the advent and spread of the EACMV serotype of the mosaic

virus in important cassava growing eco-zones and the emergence of some severe strains of the African cassava mosaic in the pathosystem highly resistant planting materials should be used for ratooning of mother plants as one of the methods to increase the production of clean planting materials for farmers. It was also indicated that, there is also the need to conduct an extensive survey in all the cassava growing areas in Ghana to determine the incidence and spread of emerging species of the cassava mosaic begomoviruses in order to develop better strategies to reduce the menace of the cassava mosaic disease in Ghana and in the sub-region as a whole (Lamptey et al., 2012).

## 3 Genetic Engineering

Genetic engineering, also referred to as Genetic modification, recombinant DNA technology or transgenesis. The technique permits scientists to identify and isolate gene of interest and move it into another plant with a lot of precision and cuts across the barrier posed by species, the common name given to the product generated is Genetically Modified Organisms (GMOs). The first GM crop approved for cultivation was the "Flavr Savr" tomato in 1994 in the USA. Since then, development of transgenic crops has been incredibly fast. The main commercially released traits are herbicide-tolerant and insect-resistant crops transformed and cropped on commercial scale include beet, rice, wheat, sunflower, sugar cane, tomato, pepper, squash, papaya, cotton.

### 3.1 Benefits and risks

Benefits and risks of GMOs are assessed through comparison of the new organism with its "conventional" counterpart (variety or food) and associated techniques (e.g. pest management or food processing techniques). With the added on the use of pesticides is reduced and, this consequently benefit the environment farmers' revenue is improved. The use of insect-resistant varieties reduces post-harvest losses caused by insect which contribute about 50% of losses. Additionally the use of herbicide-tolerant varieties help reduce soil erosion. Output traits will be of reasonable advantage to consumers as foods are healthier. Therefore, farmers, the environment and consumers benefit from the development of GMOs.

Prior to release, any new GMO go through thorough environment and food safety scrutiny, in as well as variety of registration procedures. Risk assessment carried out include: risk assessment; risk management; and risk communication and these are based on comprehensive scientific procedures. The assessments take into account the recipient and donor organisms, vector, inserted gene, gene construct, the resultant GMO, intended use, and receiving environment.

The question is that why has this field of science become necessary in crop science and agriculture? In the ancient times farmers went through the forest to collect food and selected crops that were edible with desirable traits. It has been estimated that there are about 422 000 species of angiosperms (Bramwell, 2002). However, globally, only 15 plant species are heavily utilized to feed humans and domestic animals, and 70% of these species, is produced by only three species – wheat, rice and maize (Bewley and Black, 1985). The 15 species include five cereals, two sugar producers, three subterranean crops three legumes and two tree crops. The high demand of the narrow range of cultivated plant species worldwide is the cumulative result of ever-increasing exploitation by human population and industrial demands coupled with the fail in utilisation of indigenous plants in favour of introduced and selected species (Quain, 2007). Narrowing of crop development is ongoing, where a few cultivars which are high yielding are selectively bred, bringing about genetic uniformity and eroding vital genetic diversity useful for crop improvement, conservation, and utilization (Bewley and Black, 1985). This strict selection by farmers was based typically on yields, taste and other desirable traits and has inadvertently excluded undesirable genes and included desirable genes in each new

generation of crop, culminating in our current food crops. The implications are that in the wild, there are several genes available which are vital for the existence of crops.

Following this selection by our forefathers, crop cultivation has employed the technique of crossing plant with or without human assistance. Other means that have been used to generate crops with desirable traits include the use of chemical and physical means to 'mutate' plant genes. This system happens in nature as plants develop to adjust to their changing environment and in response to biotic and abiotic stresses. It is however very slow in nature and occurs over several years. The use of chemicals and radiation however enhances this and hastens to create mutants. In mutants, existing genes are mutated and this may give rise to plants with different, and even desirable, traits. Plant breeders can then select for these desirable traits caused by the mutated gene to breed new plant varieties. Conventional breeding also crosses different species of plants to create hybrids. Plant hybrids are common in agriculture, a typical example is the triticale which is a cross between wheat and rye; this crop combines the yield of wheat with the environmental tolerance of rye, and is mainly used as fodder. Grape fruit is also a hybrid between pomelo and Jamaican sweet orange.

Conventional crosses generate several progeny and each seed is an individual. Farmers therefore go through the progeny and select the individual with desirable traits for further utilization. Conventional breeding can be done only among plants of the same species, hence having the limitation of species barrier.

In this sense when a desirable gene is found in a specie, it cannot be transferred into another specie. However, just as communication has evolved from telegraph to "WHATAPUP", crop breeding has also evolved to current genetic engineering (GE). The unique power of GE, lies in its ability to incorporate target genes into plants to develop new plants without any specie barrier. With this GE technology, genes from unrelated organisms can be combined based on the principle that genes which occur in every organism, are a sequence of building blocks and culminates into our different traits.

**3.2. How do we Genetically Modify an organism?**
There are five major steps in the genetic engineering of a crop:

1. Identification of the desired gene: In all organisms there are deoxyribonucleic acid (DNA) molecules, which store the genetic information and organize various metabolic processes. Genes are distinct sections of the DNA that generate the information needed to assemble a specific protein. The proteins in this case function as enzymes that are structural or storage units in a cell or catalysts in the biochemical reactions in the cells. These ultimately contribute to the plant expressing a particular trait as shown in the figure1 below and this is also referred to as the "central dogma of science". Hence, traits in all organisms are controlled by genes and genes make up our DNA. One therefore has to identify the particular gene that controls the expression of a particular trait. Once the gene which is a sequence of nucleotides is identified, it is isolated for the process of genetic engineering of another organism.
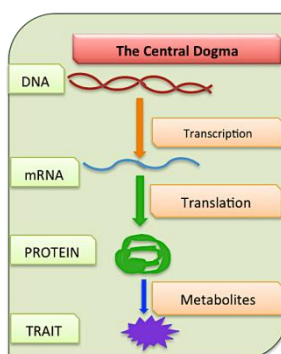
Fig. 1. The Central Dogma is the basis of all biological lives on how DNA transcribes to mRNA translates to protein which through metabolism result in the trait (phenotype)

2. Cloning of identified gene: Cloning is typically the production of exact copies of an organism. Once a specific gene has been identified, in order to use it, several copies have to be generated and this is done through the process of cloning. In the laboratory the identified gene is inserted into a bacterium and as the bacteria multiplies, several copies of the desired gene are produced. Once this is done the desire gene is isolated from the bacteria and used for the next step.

3. Design of the identified gene: A gene designed to code for a trait is made up of four main sections (Fig. 2) namely the "marker gene"; this is a selectable marker and it is a gene which code for a protein that confirms resistance to agents that are toxic to plants, such as herbicides and antibiotics. In this case when the plant cells exposed to the genes are grown on a selectable medium, only cells which have the gene of interest survive. The next section is the "promoter"; which is section that initiates the coding of the trait to be expressed in specific tissues and organisms under particular conditions and this region is specifically designed to suit required purposes. The next section is the coding region, which is the sequence that code for a specific trait and for this purpose, our gene of interest. The last region is the terminator and it is a sequence that informs the system that the gene has been coded. The designing of the gene is done with the aid of enzymes which cut undesirable regions and replace them with required regions and this process is conducted in a test tube in the lab.
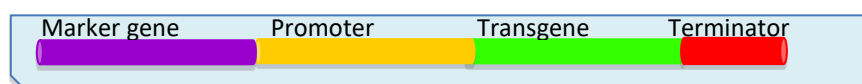


Fig. 2. A simplified pictorial representation of a Transgene with all the components needed for expression

4. Transformation of Plant tissue: This step is where the designed gene is introduced into the tissues of the target plant for transformation to occur. The most common modes of introducing the genes are agrobacterium, microfiber, electroporation and gene gun. Any of these systems when used introduces the designed gene into the nucleus of the target plant and the gene gets integrated into the plant's DNA. Tissue culture techniques are then used to grow the tissues which carry the introduced gene into whole plants. The regenerated plants are tested for the presence of the new gene and the genetically engineered plants are grown further to maturity in the greenhouse.

5. Backcross Breeding: To ensure that the new gene is stable and properly integrated into the genome of

preferred elite line, the genetically engineered crop is crossed with elite line and the offspring are backcrossed a number of times to ensure the introduced gene is fixed, and its efficacy is established. The genetically engineered crop then goes through rigorous screening following biosafety guidelines before it is released for commercial production. These processes from gene identification to production of a transgenic plant can take 6 to 15 years.

GE crops were first grown on commercial scale in 1996 and this covered 1.7 million hectares. As of 2013, more than 175 million hectares of land has been cropped with GE on commercial basis Fig 3. This is more than a 100 fold increase which makes biotechnology crops the fastest adopted technology in recent times (Clive James 2013).
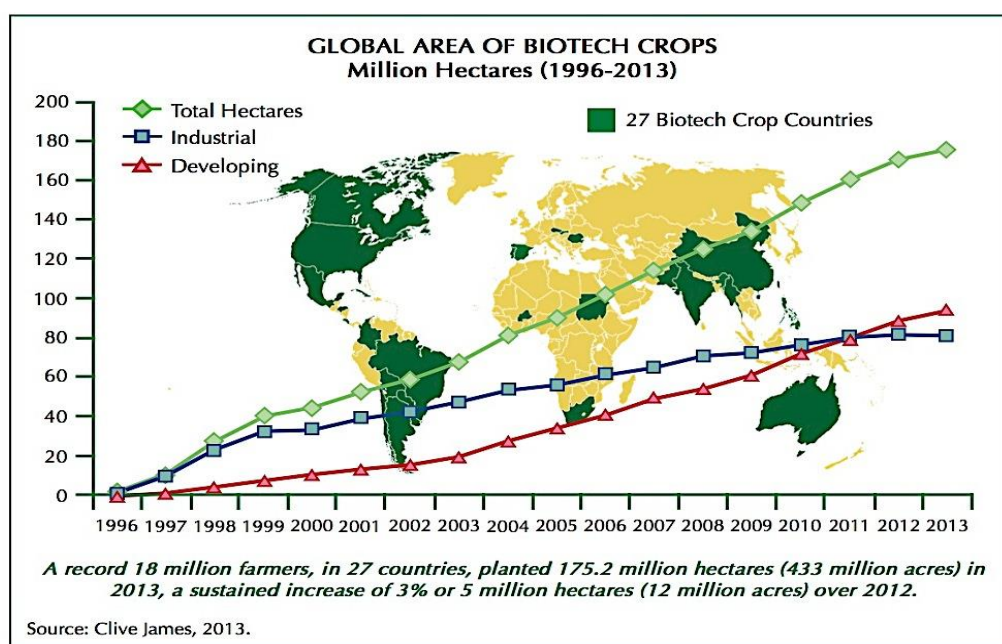


Fig. 3 Global Status of Commercialized Biotech/GM Crops: 2013

Worldwide, GE crops are grown on commercial scale in 27 countries, made up of 19 developing and 8 industrial countries. The developing countries are cropping 54% comprising 94 million hectares. Mostly traits

that have been targeted in the development of GE crops are pest resistance, herbicide tolerance and crop quality. The following crops have been genetically modified: soybean, maize, canola, cotton, alfafa, papaya, poplar

tree, potato, tomato, sugarbeet, and sweetpepper (ISAAA 2013). A 2011 study by the Forum for Agriculture Research in Africa (FARA) revealed that agricultural biotechnology in general is being increasingly adopted as a strategic tool for improving crops and livestock productivity in Africa. Several institutions in Ghana have initiated applied research and training in modern agricultural biotechnology with the aim of improving crop yields and quality (FARA, 2011).

**3.3. Genetic Engineering Initiatives in Ghana**
Currently in Ghana, three confined field trials (CFTs) for rice, cowpea and cotton are being evaluated under strict compliance with the Biosafety act 2011 Act 831, which regulates GMOs was passed in 2011. The trials are being conducted in Ashanti and Northern regions. Traits for nitrogen use efficiency, water use efficiency and salt tolerance have been incorporated into rice whilst resistance to the pod borer *Maruca* has been incorporated into cowpea. These traits were donated royalty-free to African countries through the African Agricultural Technology Foundation (AATF). No Commercial company will control production of varieties found to be suitable, and indeed CSIR breeders are expected to further utilize lead events in their breeding programs. These trials if successful, will have the following benefits: rice that can grow well in soils with high level of salts as found in the Greater Accra and Volta regions of Ghana, The governm
ent sector, which is indicative that biotechnology is mainly utilized by governmental organizations. Therefore the involvement of the government in biotechnology initiatives in Ghana is crucial. However, the private sector needs to be motivated to be involved in biotechnology since they are the major beneficiaries. The results revealed that most of the organisations using biotechnology tools in Ghana are using it

fertiliser application during the growth period will be reduced because the plants have in-cooperated in them the ability to efficiently utilise nitrogen and the crop can thrive under limited moisture regime.. Also the moths (maruca) which devastate cowpea in the farmers fields will reduced as the plants have the inherent ability to tolerate and control the insects. The use of pesticides when cowpea is growing will be reduced and this is vital for our environment. These processes are not being controlled by multinationals as peddled by critics. Currently our neighbours in Burkina Faso are growing on commercial scale GE cotton, which has enabled them to reduce the application of pesticides on their fields from 6 sprayings to 2 sprayings from planting to harvest. The cotton yarn harvested is also of better quality and currently Ghanaian researchers are conducting CFTs of the cotton to establish their efficacy in Ghana.

**3.4. Genetic Engineering Survey outcome in 2011**
A brief survey on the status and opinion of biotechnology adoption in Ghana was conducted in 2012. The focus group was members of the National Biosafety Committee, farmers, regulators, researchers and lecturers in the field biotechnology and related areas in Ghana, and there were a total of 40 respondents (Quain and Egnin 2014). The type of organizations surveyed comprised 7.5% from the private sector, and 92.5% from

for research (60%) and teaching (25%) as shown in the Figure 4 below: Clearly some of the respondents are both in research and teaching fields. Teaching is the second highest category (25%) and administrative the least (1.7%). This response is a clear indication that currently in Ghana, potential organizations to be involved in GE are in the research institutions, while the regulatory and administrative aspects calls for improvement over a period of time.
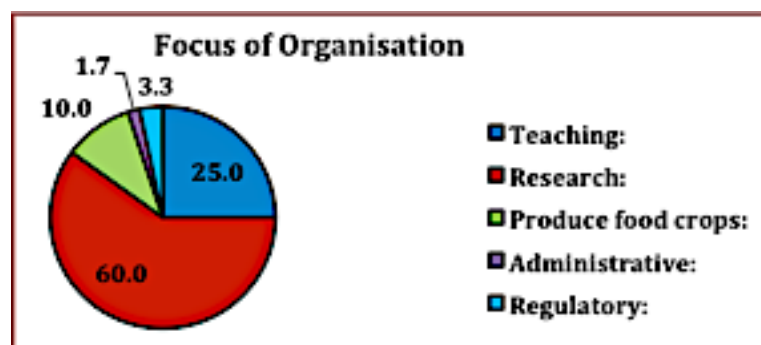
**Figure 4:** The Distribution of Biotech Organisation Focus in Ghana. (source: Quain and Egnin 2014)

The biotechnology tools being used in Ghana are micropropagation for multiplication of vegetatively propagated plant material, molecular breeding for rapid selection of desired progeny and germplasm conservation. The use of polyclonal and monoclonal antibodies as well as DNA probes in diagnostics. Currently, with the exception of CFTs mentioned above being conducted, under strict supervision by the National Biosafey Committee (NBC), there are no laboratory and field experiments or commercial release ongoing in Ghana on GE technology. When the question "Do you have the capacity to screen for genetically modified crops and their products" was posed, 62.5% of respondents indicated lack of facility; 37.5% had the facility and 5% did not have the infrastructural facility but all the groups possessed necessary skills. This 38% of respondents having the facilities to screen for GEs, bring us to the conclusion that, adequate facilities are available to handle GE crops in Ghana. A total of 65% of the respondents indicated that they would like to use their research to introduce genetic engineering into Ghana and proposed a commercial release time line of two – ten years. This reveals that the Ghanaian researchers will do genetic engineering and due to the various processes earlier listed it will take time for commercial release of products onto our markets. The fears of the respondents were that generally, Ghanaians are unaware of the benefits of GE technology and even the well educated finds it difficult to understand this area of science. They were thus of the view that Ghanaians

may not accept the introduction of GE crops, although the derivatives thereof are already in our markets, supermarkets, and the technology is applied in production of insulin and vaccines. The need for intense education was therefore paramount. This pose a challenge for The National Biosafety Committee of Ghana, whose main responsibility is to educate scientists, administrators and the general public on the risks as well the benefits of introducing GE crops. The survey concluded that to efficiently adapt this technology, there is the need for training activities tailored towards generating interest and creating awareness in GE technology, well equipped, and maintained laboratories, containment and confinement facilities with personnel having the requisite skills and also, additional efforts are needed for the effective implementation of a biosafety framework and harness infrastructural capacity, in order to facilitate the introduction of GE crops. Ultimately, the use of GE crops and their products need to be encouraged.

**4. Way forward and conclusion**
Modern Biotechnology is a fast advancing technology in this global village. The tools in it are being used to improve livelihoods and understand science. Ghana has to employ the available means to join the train. The tools require specialized expertise and are is expensive, although it is not the panacea for all our agriculture problems and it should be utilized when needed to compliment the conventional tools being used. From the survey conducted, it is apparent that the majority of

respondents are in favor of introducing GE crops in Ghana and expressed faith in the technology towards enhanced food production, nutritional and economic growth. Ghana needs to make substantial investment in cutting edge technologies and in the human resource development. Policies need to be harnessed to ensure biosafety and sustainability of the deregulated GE crops. The ultimate aim of our efforts is to alleviate poverty, hunger and malnutrition in the sub-Saharan region. Public education is crucial as all stakeholders need to make informed decisions based on information from credible sources.

**Reference:**

Abrokwah A.L.C. Kwoseh, T. Carley, **M.D. Quain**, E. Parkes and A. Oppong (2013). Characterisation of Begomoviruses strains found on Sweetpotato in Ghana.12th Triennial Syposium International Society for Tropical Root Crops –Africa Branch(ISTRC-AB) Book of Abstracts, p.318

Appiah-Kubi D., J.Y. Asibuo, **M.D. Quain**, A. Oppong, R. Akromah (2014). Diversity studies on soybean accessions from three countries. *Biocatalysis and Agricultural Biotechnology***3** pp. 198–206

Asibuo, J.Y., **M.D. QUAIN**, P.F. Ribeiro, A. Agyeman, R.N. Prempeh, L. Aboagye (2011). SSR finger printing of conserved yam germplasm in Ghana. The West Africa Root and Tuber Crops Conference, p 30

Bewley, J.D. and Black M. (1985). *Seeds. Physiology of development and germination.* Plenum Press, New York.

Bramwell, D. (2002). How many plant species are there*? Plant Talk* **28**.

Cohen, S.N., A.C.Y. Chang, H.W. Boyer and R.B. Helling, (1973). Construction of Biologically Functional Bacterial Plasmids *In Vitro.* Proc Natl Acad Sci U S A. Nov 1973; 70(11): 3240–3244.

FARA (Forum for Agricultural Research in Africa). 2011. *Status of Biotechnology and Biosafety in sub-Saharan Africa: A FARA 2009 Study Report.* FARA Secretariat, Accra, Ghana.

Gayral P., Iskra – Caruana M.L. (2009). Phylogeny of *Banana Streak Virus* Reveals Recent and Repetitive Endogenization in the Genome of Its Banana Host (*Musa* sp.). Journal of Molecular Evolution. Volume 69, Issue 1, pp 65-80

ISAAA 2013 http://isaaa.org/resources/publications/briefs/46/topfacts/default.asp

James, C. (2013). Global Status of Commercialized Biotech/GM Crops: 2013. ISAAA Brief No. 46. ISAAA: Ithaca, NY. ISBN: 978-1-892456-55-9

Lamptey, J.N.L., **M.D. Quain**,E. OwusuKyere, P.F. Ribeiro, R. Prempeh, and L. Abrokwa (2012) Effect Of Cassava Mosaic Disease on Successive Ratooning of some cassava cultivars.*Ghana Journal of Agriculture Science*, **45**pp 11-19 ISSN 0855-0042.

Oppong, L.A., **M.D. Quain**, A. Oppong, H.A. Doku, A. Agyemang, and K. Offei Bonsu (2014). Molecular Characterization of Solanum Species Using EST-SSRs and Analysis of Their Zinc and Iron Contents. *American Journal of Experimental Agriculture* **6(1)**: 30-44, 2015, Article no. AJEA.2015.062 ISSN: 2231-0606

Osei, M.K., R. Akromah, J.N.L. Lamptey and **M.D. Quain** (2012). Phenotypic and molecular screening of some tomato germplasm for resistance to tomato yellow leaf curl virus disease in Ghana.*African Journal of Agricultural Research* Vol. 7(33), pp. 4675-4684. Available online at http://www.academicjournals.org/AJAR DOI: 10.5897/AJAR12.672 ISSN 1991-637X

©2012 Academic Journals

Otoo, J. A. and **QUAIN, M. D**. (2001). Comparative studies of *in vitro* cleaned planting material and field selected apparently clean sweet potato planting material in proceedings of 8th International Society for Tropical Root crops - Africa Branch (ISTRC-AB) symposium at Cotonou 2001.

Parkes E. Y., **M. Quain**, J. Asafu Agyei,E. Moses, G. Ampong Mensah ,E. Okogbenin, C. Egesi, A. Bellotti and M. Fregene (2007). Using Molecular Breeding to fast-track release of Delayed PPD and Disease Resistant Cassava in Ghana. Presented at Annual Research Meeting of Generation Challenge Programme (GCP) 12–16 September 2007 in Pretoria South Africa.

Parkes, E.Y., B. Boakye Peprah,  E. Lotsu, P. AdofoBoateng, R. Thompson, and M.D. Quain, (2009). Evaluation of cassava F1 genotypes and progenitors resistant to Cassava Mosaic Disease (CMD) for the putative presence of the CMD2 resistant gene using molecular markers. Presented at the Annual Research Meeting of the Generation Challenge Program (GCP). Held on 20−23 September 2009 at Bamako, Mali.

Prempeh, R.N., QUAIN M.D., Parkes E.Y., Afriye-Debrah C., Humberto G. (2011). Assessing genetic diversity in conserved cassava (Manihotesculentum) germplasm collections in Ghana using Simple Sequence Repeat (SSR) markers. The West Africa Root and Tuber Crops Conference, P. 49.

**QUAIN** Marian D., and M. Egnin (2014), Current Status and Future Direction for Research on Agricultural Biotechnology in Ghana. *Genetically Engineered Crops in Developing Countries Eds.*: DVR Reddy, P Ananda Kumar, P Lava Kumar, G Loebenstein & C Kameswara Rao. Studium Press LLC, Houston, USA. 2014; pp. 377-397

**QUAIN** MD and B.M. Dzomeku (2013) Clean Planting Materials Produced *in Vitro* to Improve Performance of Sweet Potato, Plantain and Bananas in Ghana. *Biotechnologies At Work For Smallholders: Case Studies From Developing Countries In Crops, Livestock And Fish.* Edited By J. Ruane, J.D. Dargie, C. Mba, P. Boettcher, H.P.S. Makkar, D.M. Bartley and A. Sonnino ISBN 978-92-5-107877-8 (print) E-ISBN 978-92-5-107878-5 (PDF) Pp 27-36

Quain M.D., P. Adofo-Boateng, B. Mensah Dzomeku, A. Agyeman (2010a).   Multiple Shoot Generation Media for *Musa sapientum* L. (False Horn, Intermediate French Plantain and Hybrid Tetraploid French Plantain) Cultivars in Ghana. *The African Journal of Plant Science and Biotechnology.* 4 (Special Issue 1), pp. 102 – 106. © 2010 Global Science Books.

**Quain, M.D**., R Thompson, E.L. Omenyo, J.Y. Asibuo, D. Appiah-Kubi, P. Adofo-Boateng (2010b).   Assessing   transferability   of Sweetpotato EST SSR primers to cocoyam and micropropagation of nine elite cocoyam varieties in Ghana. *Aspects of Applied Biology* 96, Agriculture: Africa Engine for Growth - Plant science and biotechnology hold the key. pp. 269-276.

Quain,    M.D.,    (2007).    *Complementary Conservation of Root and Tuber Genetic Resources - Dioscorea species and* Solenostemon rotundifolius. Thesis submitted to the Botany Department University of Ghana Legon for the Doctor of philosophy

Seal S., Turaki A., Muller E., Kumar PL., Kenyon L., Filloux D., Galzi S., Lopez-Montes A., Iskra-Caruana ML. The prevalence of badnaviruses in West African yams (*Dioscorea cayenensis-rotundata*) and evidence of endogenous pararetrovirus sequences in their genomes. *Virus Res.* 2014 Jun 24; **186**:144-54. doi: 10.1016/j.virusres.2014.01.007

Twumasi, P., E.W. Acquah, M.D. Quain and E.Y. Parkes (2014). Use of simple sequence repeat (SSR) markers to establish genetic relationships among cassava cultivars released by different research groups in Ghana. International journal of Genetic and Molecular Biology, Vol 6 (3) DOI:10.5897/IJGMB2014.0097, Article Number: DD0F75D48246, ISSN 2006-9863, pp. 29-36

U.S. Government Printing Office. (1976) *Guidelines for research involving recombinant DNA molecules*. **41**. 27911–27943. OCLC 43751041.

Watson JD, Crick FHC (1953) A structure for deoxyribose nucleic acid. *Nature*, **171**, 737–738.

# Exploring the Skills Set Development and its Job Market Relevance of the HND Purchasing and Supply Programme.

**[1] Smile Dzisi, [2]Lomatey Isaac Toku, [3] Joshua Ofori-Amanfo**
[1] Department of Purchasing and Supply, Faculty of Business and Management Studies,
Koforidua Polytechnic
[2] Department of Purchasing and Supply, Faculty of Business and Management Studies, Koforidua Polytechnic
[3]Pentecost University College, Faculty of Business Administration
Email: afuasmile@yahoo.com

**Abstract**

The study explores the skills set development and its job market relevance of the HND purchasing and supply programme in Ghana, using a grounded theory methodology. Semi-structured interviews, focus group discussions, observation and documentary analysis were used in the data collection whereas thematic analysis was applied in the data analyses process. The research findings supported the widely held public perception that skills mismatch exist on the Ghanaian labour market. Besides, the HND Purchasing and Supply practitioners were found to lack managerial skills, confidence (psyche), analytical skills, critical thinking skills, specification development skills, computer skills in terms of data entering, word processing, excel and power point capabilities. Unfortunately, the study did not establish the existence of any practical on the job training in industry to resolve the identified skills deficiency. Although the research revealed that the Public Procurement Authority (PPA) has been organizing some internships for HND Purchasing and Supply graduates, they still lack hands-on/ practical experience. Nonetheless, the study has confirmed the relevance to practice of the skills set imparted through HND Purchasing and Supply programme.

**Keywords:** skills set; skills mismatch; purchasing and supply; job market; Polytechnics.

## 1. INTRODUCTION

The introduction of the HND Purchasing and Supply programme in some Polytechnics in Ghana about some twenty years ago is an attestation of the increasing significance of purchasing skills in Ghana. Prior to the introduction of the HND programme, purchasing education was non-existent in the country's tertiary education system. Persons interested in purchasing and supply management qualification had to pursue the UK-based Chartered Institute of Purchasing and Supply programme. Currently, some private universities and government universities have introduced degree programmes in supply chain management. All these developments point to the growing demand for supply management professionals and ultimately higher purchasing and supply skills in the country. The passage of the Public Procurement Law in 2003 by the Ghana government for example is in recognition of the importance of purchasing requiring qualified professionals with adequate skills to manage public sector procurement.

There are many who share the concerns that some tertiary education programmes are completely out of touch with specific industry needs. The argument people often put up to support this claim is that many tertiary institutions develop academic programmes without any significant input from industry experts. The consequence of this seeming negligence if it is really the case is the production of graduates whose skills level fall short of industry requirement making it difficult for such graduates to get jobs leading to high graduate unemployment situation or perform poorly on the job even when they find one. The Polytechnic as a tertiary institution has to grapple with increasing number of

graduate unemployment of which it's HND Purchasing and Supply graduates are no exception.

Skills set are important asset for individual workers and firms in the world we live in today. However, the development of appropriate skills for the labour market has become a global issue. The Wold Economic Forum (WEF-2014) observes that policy-makers and social partners across the globe are increasingly becoming concerned with the mismatch between their workforces' skills and their labour markets' needs. The gap between the skills needed to perform a job and the actual skills possessed by individuals is referred to as 'skills mismatch' (WEF, 2014). Higher Education (HE) plays a crucial role in the development of appropriate skill sets for the labour market. Recent years have seen increasing concerns being shared by employers in Ghana with regards to the skills set imparted by Ghana's HE system. The perception has been that the skills set imparted by some HE programmes do not match industry needs. The argument people often put up to support this claim is that many tertiary institutions develop academic programmes without any significant input from industry experts and with no recourse to trends on the labour market. The situation may induce high rates of graduate unemployment and mismatches in qualifications. Skills mismatch raises the question of the extent to which graduates from Ghanaian Universities and Polytechnics will be able to contribute to the profitability of the firms they work for with consequences on the wellbeing of the economy. WEF (2014) argues that poorly educated workforce, skills shortages and an under-skilled workforce tend to compromise economic development in developing and emerging economies. There is speculation on the Ghanaian labour market of the presence of skills mismatch

which contributes to the alarming levels of graduate unemployment that requires urgent attention. Again, the changing business environment has placed an urgent need on purchasing professionals to possess high level dynamic skills and higher educational institutions have the responsibility to promote this agenda.

Based on the literature prescription of the skill set requirement for the purchasing and supply profession and how university programmes are designed to deliver them, one might want to know if the HND Purchasing and Supply programme equip students with the required skill set and whether these skill set is what the Ghanaian industry needs. Our focus in this paper is to explore the market relevance of the skill set imparted by the HND purchasing and supply programme.

## 2. SKILL SET IN ORGANISATIONAL MANAGEMENT

Sauber *et al.*, (2008) maintain that the need to educate professionals and equip them with new and higher-level skills have become urgent. Peterson and Van Fleet (2004) define skill as the ability either to perform some specific behavioural task or the ability to perform some specific cognitive process that is related to some particular task. Similarly, Elias and McKnight (2001:511) define skills as the "ability to carry out the tasks and duties of a job in a competent manner". Carla (1992) also describes skill as the learned capacity to carry out pre-determined results often with the minimum outlay of time, energy, or both. Thurow (1994) emphasised that in the 21st century where organisations have virtually equal access to almost all resources, the skills to perform the job becomes a very important competitive factor. Thus it is the skills to effectively and efficiently

execute job functions that make the difference between successful and failing organisations.

Skills needed for successful operation and management of an organization according to Carla (1992) includes; skills to learn; basic competence skills, computational skills; communication skills; problem-solving and creative thinking skills; self-esteem skills, motivation/goal skills; group effectiveness skills, interpersonal skills; organizational skills and leadership skill. It is widely believed that skills can positively influence not only humans but also firm's performance (Tassabehji and Moorhouse, 2008). According to Giunipero and Pearcy (2000) there are seven types of skills. They explain them as; Strategic Skills: that consists of: (1) strategic thinking, (2) supply base research, (3) structuring supplier relationships, (4) technology planning, and (5) supplier cost targeting; Process Management Skills: requires five key skills: (1) organization/ time management, (2) tactfulness, (3) written communications, (4) problem solving, and (5) conflict resolution; Team Skills: consists of teamwork, leadership, managing change, managing internal customers, and salesmanship; Decision making Skills: is of only two skills — ability to make decisions and computer literacy; Behavioral Skills: is composed of interpersonal communication, risk taking/entrepreneurial, creativity, and inquisitiveness; Negotiation Skills: The negotiation factor consists of four key skills: (1) negotiation, (2) customer focus, (3) influencing and persuasion, and (4) understanding business conditions and Quantitative Skills is composed of four skills: (1) computational, (2) technical, (3) blueprint reading, and (4) specification development. These type of skills highlight supply management as an important dimension of the operations of every organization

which ought to be managed by people with the requisite skill set and experience.

## 3. CHANGING LANDSCAPE OF PROCUREMENT SKILLS

Cousins *et al.,* (2006) state that skills requirement for purchasing professionals have changed considerably over the years perhaps due to the evolving nature of the profession. According to Cousins and Spekman (2003), a more sophisticated set of procurement skills and competences are required to effectively manage the buyer-supplier interface of the firm within the context of a global competitive environment. Cousins *et al.,* (2006) further, contend that the role of purchasing has shifted from that of a buyer, focusing predominantly on price, delivery and quality, to that of managing strategic long-term, complex agreements between internal stakeholders and suppliers. Emphasis seems to be focused on overall total costs reduction, supplier coordination, supplier development, supplier market research, cost analysis, sourcing strategy formulation, benchmarking and outsourcing decision (Cousins *et al.,* 2006; Carr and Smeltzer, 2000). Literature therefore suggest that procurement professionals now operate in a changing and dynamic environment and therefore makes it imperative for them to continuously update their existing skills in order to make any meaningful contribution to the financial, operational and strategic success of the firm (Tassabehji and Moorhouse, 2008; Giunipero and Pearcy, 2000; Giunipero *et al.,* 2005).

Higher education, the knowledge base of industry, has a critical role to play in equipping purchasing professionals with these dynamic skills to meet the challenge. It has also been proven that enhanced purchasing skills affects organisational performance (Cousins *et al.,* 2006; Carr and Smeltzer, 2000).

Cousins *et al.,* (2006) for instance found that high skill levels and knowledge in purchasing do impact significantly on the financial performance and operational efficiency in terms of quality improvement, design and reduction of lead times. Kolchin and Giunipero (1993) categorised skills requirement for purchasing into three areas namely, business skills, interpersonal skills and technical skills. Business skills include the ability to undertake market analysis, negotiation, manage relationships, global sourcing development, change management and planning and organisational skills. Interpersonal skills include risk taking, written and oral communication, conflict resolution, influence and persuasion, group dynamics, leadership, problem solving and international and cultural awareness. Examples of technical skills on the other hand include cost analysis, product knowledge, computer literacy, total quality management and government legislation (Humphreys *et al.,* 2000).

This view is shared by Giunipero *et al.,* (2006) who add that as purchasing functions oscillate more towards the strategic approach in businesses, the key skill set required by these professionals include team building skills, strategic planning skills, communication skills, technical skills and broader financial skills.

The literature view that enhanced purchasing skills significantly influence firm performance (Cousins *et al.,* 2006; Carr and Smeltzer, 2000), makes it imperative for purchasing and supply graduates to possess a skill set which will enhance their contribution towards corporate success. Carr and Smeltzer (2000) note that a number of universities have recognised the need to incorporate purchasing and supply management in their curriculum due to the growing recognition and demand for this type of

business skills. The authors further add that these programmes have undergone considerable curriculum change over time in an effort to focus on the skill sets that most organisations desire when hiring candidates. It is without doubt that the changing business environment has placed an urgent need on purchasing professionals to possess high level dynamic skills. Higher educational institutions represent the foundation for developing job market relevant skills and therefore have a greater responsibility in ensuring that such skills set are embedded in their degree and HND programmes.

## 4. METHODOLOGY

This study was exploratory in nature; hence the grounded theory approach was used. Thomas *et al.,* (2011) state that grounded theory is discovery oriented, employing interpretative qualitative research methods to examine phenomenon that challenges people. According to Straus and Corbin (1998) the grounded theory approach is very suitable for investigating challenging social processes. The research team is not aware of any existing research which has examined the skills mismatch for the HND Purchasing and Supply graduate. Since little is known about the phenomenon, Straus and Corbin (1998) maintain that qualitative methods are considered the appropriate research approach for initial discovery oriented inquiries. Based on this theoretical premise, we utilised qualitative methods in the data collection process. This approach enables the researchers to describe perceptions more accurately and thoroughly, interact with the staff in real day-to-day organizational contexts, have access to authentic and open answers from respondents because they are operating in their natural

organizational settings. Observations, conversations, documentary analysis, semi-structured interviews and focus group discussions were used for the data collection exercise.

The categories of respondents for the study included Chief Executive Officers, heads of Procurement and Human Resource Managers who are part of top management, and practicing HND Purchasing and Supply graduates. The industries surveyed for the study were, Manufacturing, Education, Distribution, Banking and Hospitality (hotels). These industries were used on the basis of these being perceived to be the key market destinations for the practicing HND Purchasing and Supply graduate. Interviewees were purposefully selected using availability and willingness to participate as key criteria. This sampling technique was used because in a research like this the researchers have to hand pick the subjects or respondents who in the opinion of the researchers have the knowledge and information the researchers are interested in.

A total of 3 focused group discussions were conducted in addition to 50 interviews comprising 20 senior managers from 20 organisations (employers) and 30 practicing HND Purchasing and Supply graduates. Semi-structured interviews were used as this provided the advantage of exploring issues of interest further when they emerged in the conversations. Documentary analysis was used to complement data collected from the semi-structured interviews. Documents analysed included the syllabus and study materials for the HND Purchasing and Supply programme. Upon the completion of interviews all audio-taped data were transcribed into word format. Thematic analysis (Silverman, 2005) was employed to reveal recurring themes from the data. This involved obtaining an overview of the material and identifying patterns and major ideas emerging from the interviews. Findings emerging from the analyses are discussed in the next section.

## 5. RESULTS

On the whole, interviewees (85% of the HND Purchasing and Supply practitioners) admitted that strategic skills, process management skills, team skills, decision-making skills, behavioral skills, negotiation skills and quantitative skills are important in their daily operations. Majority of the CEOs revealed that HND purchasing and Supply practitioners lack managerial skills, confidence (psyche), analytical skills, critical thinking skills, specification development skills, computer skills in terms of data entering, word processing, excel and power point. Many CEOs were of the view that although the Public Procurement Authority (PPA) organizes some internship for HND Purchasing and Supply graduates when they were in school, they still lacked hands-on/ practical experience.

Interviewees cited Public Sector Procurement, Shipping and Forwarding, Logistics Management and Operations Management as key skill source for the purchasing and supply profession which unfortunately are excluded from the HND Purchasing and Supply curricula. Particularly in the public sector employment, HND Purchasing and Supply practitioners were found to be placed as junior staff as prescribed by government policy. Interviewees indicated that the professionalism of the practicing HND purchasing and supply graduate has more room for improvement. Unfortunately, the availability of practical training opportunities on the job seems to be very much limited.

Nearly all the practicing HND purchasing and supply graduates shared the view that teaching methods in the Polytechnic's HND Purchasing and Supply programme are more theoretical than practical. This, the interviewees believed is contributed to by the fact that most teaching staff engaged in delivering the purchasing and supply curricula have no industrial experience. One interviewee comments that "the read to teach approach seriously undermines the essence of the programme". An interesting revelation was the finding that in both the private and public sectors, other professionals such as Marketing, Engineering etc. were found in top positions of the procurement function, whilst a lot of the HND Purchasing and Supply practitioners were found in supporting roles. The next section examines the interviewees' response to the fundamental questions in the interview guide.

## 5.1 What are industry's expectations of the skills set of HND Purchasing and Supply graduates?

Majority of the interviewees considered the skill set thought in schools (HND Purchasing and Supply programmes) to be relevant to what they do in industry. They however, observe a shortfall in the overall skills requirement for effective practice. The skill deficiency was identified as the inability to write reports and communicate effectively; lack of critical analytical thinking skills; profound weakness in statistical analysis; and inability to work without or with little supervision.

Practising HND Purchasing and Supply graduates describe the key skills relevant to their practice to include strategic management skills, operations and process management skills, team skills, decision-making skills, behavioural skills, negotiation skills and quantitative skills. Though the majority of the practitioners (over 80%) claim their level on these

skills is high, we found this claim to be inconsistent with the curricula of the programme. An analysis of the curricula for the programme reveals that apart from negotiation skills, very negligible attention is paid to the development of the other skills as admitted by the practitioners. Thus the skills imparted fall short of the skills requirement for the trade, hence confirming the widely held perception of the existence of skills gap on the Ghanaian labour market.

## 5.2 What skills set are required of staff in the supply management function?

The analyses indicate that the supply management function plays a critical role in all organizations. POLY 3 posit that "we procure goods worth billions of cedis for our operations and without the supply function, we will be adding more costs than profit. The supply management function is an integral part of the firm contributing to meeting corporate objectives.  So it is very important". POLY 7 supported by adding that "strategically, procurement management becomes the engine of the whole organization, because the request are processed and by the close of the day, what the institution needs in terms of teaching and non-teaching needs are procured by the procurement function. So it's very important". He added that it also helps businesses to address client needs while enabling them to realize opportunities for cost savings and better potential return on investment. When asked the skills set needed to mind the function, the skills mentioned by majority of the respondents includes; Strategic thinking, critical thinking, written and interpersonal communications, problem solving, teamwork skills, decision making skills, computer literacy, creativity, and inquisitiveness, negotiation skills and quantitative skills, leadership skills, planning and

organizational skills, risks taking skills and professional skills all of which support earlier findings by Giunipero and Pearcy (2000), Giunipero *et al.,* (2006) and Carla (1992).

**5.3 What are the skills set deficiencies of the HND Purchasing and Supply graduates?**

The focus group discussions resulted in a consensus that established that a gap exist between the skills set imparted and the relevant skills set required for practice. There was consensus among the employers interviewed that the majority of the HND practitioners lack strategic skills, managerial skills, confidence, analytical skills, critical thinking skills, specification development skills, and have very low proficiency in Microsoft Office applications. This evidence appears to be consistent with our analysis of the curricula.

All the HND Purchasing and Supply graduates interviewed also agreed indeed they lack some skills requirement to undertake their job roles effectively. It was evident that these skills gap emerges from the deficiencies in the curricula they went through in higher education. When further asked whether there are training programmes instituted by employers to fill these gabs, they all responded in the negative. One of the respondent Poly11 stated that *"Ok, currently I am not personally aware because I have been here for close to two years and I have never seen or heard about any training programme"* Poly13 added by lamenting that the institution doesn't have any plan for training and that training comes with a cost.

**5.4 How relevant is the skills set imparted to HND Purchasing and Supply graduates to practice/ industry needs?**

Response from majority of employers and HND Purchasing and graduates suggests that the skill set impart through the HND Purchasing and Supply programme is relevant to practice. . It was also observed that majority of HND purchasing and supply graduates were employed into the supply function of most organizations. This was found to be as a result of government policy to recruit HND Purchasing and Supply graduates into the lower ranks of the supply function. . Thus even though is perceived to deliver relevant skill set, the level of skills imparted significantly fall short of the extent of skills requirement for effective performance.

**6 CONCLUSION.**

Given that supply management is evolving towards a more strategic orientation, it is important for firms to employ purchasing professionals having the skills and abilities required to maximize the purchasing function's contribution to overall corporate performance. The literature seems to suggest that procurement professionals now operate in a changing and dynamic environment and therefore makes it imperative for them to continuously update their existing skills in order to make any meaningful contribution to the financial, operational and strategic success of the firm. The outcomes of this study indicate that HE as the knowledge base of industry, has a critical role to play in solving the skills gap as established. The required skills established may be adopted by HE institutions to enhance the training of purchasing professionals and thereby increase the professional visibility this categories of professionals. In conclusion, the study has established the presence of a skills gap and identified the relevant practising skills which require inclusion in the HND Purchasing and Supply curricula. The paper largely contributes to the teaching and learning process within the

purchasing and supply management profession as knowledge from the study may be adopted by HE institutions in their design of supply chain management related courses.

## REFERENCES

Cala, L., 1992. Retraining 50 Million Americans: The Electronically Mediated Solution. *Ed, The Official Publication of United States Distance Learning Association, 6 (1), 4-9.*

Carr, A.S. & Smeltzer, L.R. 2000. An empirical study of the relationships among purchasing skills and strategic purchasing, financial performance and supplier responsiveness. *Journal of Supply Chain Management,* 36 (3), 40–54.

Cousins, P. D. & Spekman, R. 2003. Strategic supply and the management of inter- and intra-organisational relationships. *Journal of Purchasing and Supply Management, 9*, 19-29.

Cousins, P.D., Lawson, B. & Squire, B., 2006. An empirical taxonomy of purchasing functions. *International Journal of Operations and Production Management*, 26 (7), 775–794.

Diener E. and Crandall R. (1978) 'Ethics in Social and Behavioural Research.'University of Chicago Press, Chicago.

Elias, P. & Mckniight, A. 2001. Skill measurement in official statistics; recent developments in the UK and the rest of Europe. *Oxford Economic Papers*, 3, pp. 508-40.

Frankel, J. R., & Wallen, W.W. (2000). How to design and Evaluate research in education. (4th ed.) Boston: McGraw-Hill.

Giunipero, L., Handfield, R. B. & Eltantawy, R. 2006. Supply management's evolution: key skill sets for the supply manager of the future. *International Journal of Operations & Production Management,* 26**,** 822-844.

Giunipero, L.C. & Pearcy, D.H., 2000. World class purchasing skills: an empirical investigation. *Journal of Supply Chain Management,* 36 (4), 4–13.

Giunipero, L.C., Denslow, D. & Elantawy, R. 2005. Purchasing and supply chain management flexibility: moving to an entrepreneurial skill set. *Industrial Marketing Management*, 34 (6), 602–613.

Humphreys, P., 2001. Designing a management development programme for procurement executives. *The Journal of Management Development*, 20 (7), 604–626.

Humphreys, P., Mcivor, R. & Mcaleer, E. 2000. Re-engineering the purchasing function. *European Journal of Purchasing & Supply Management, 6***,** 85-93.

Kolchin, M. & Giunipero, L., 1993. Purchasing Education and Training: Requirements and Resources. *Center for Advanced Purchasing Studies*, Tempe, AZ.

Peterson, O.T. & Van Fleet, D.D. 2004. The ongoing legacy of R.L.Katz: An updated typology of management skills. *Management decision*, 42 (10), 1297-1308.

Sauber, M.H., Mcsurely, H.B. & Tummala, V.M.R. 2008. Developing supply chain management program: a competency model. *Quality assurance in Education*, 16 (4), 375- 391.

Silverman, D. (2005). *Doing qualitative Research 2ⁿᵈ Ed*. London. Sage.

Strauss, A.L. & Corbin, J. 1998. *Basics of Qualitative Research: Techniques and Procedures for*

*Developing Grounded Theory*, Sage Publications, Berkeley, CA.

Tassabehji, R. & Moorhouse, A. 2008. 'The Changing Role of Procurement: Developing Professional Effectiveness. *Journal of Purchasing and Supply Management*, 14 (1), 55-68

The Public Procurement Act of Ghana, Act 663 of 2003

Thomas, R. W., Esper, T. L. & Stank, T. P. 2011. Coping with time pressure in interfirm supply chain relationships. *Industrial Marketing Management,* 40**,** 414-423.

Thurow, L. 1994. New game, new rules, new strategies. *RSA Journal CXLII* (5454), 50–56.

World Economic Forum. 2014. Matching skills and labour market needs: building social partnerships for better skills and better jobs. Available at http://www3.weforum.org/docs/GAC/2014/WEF_GAC_Employment_MatchingSkillsLabourMarket_Report_2014.pdf (accessed on March 2, 2015)

**Boateng P[1]; Chen Z[2]; Ogunlana O[2]**

[1] *Scott Sutherland School of Architecture and Built Environment, Robert Gordon University, Aberdeen, UK*

[2] *School of Energy, Geoscience, Infrastructure and Society, Heriot-Watt University, Edinburgh, Scotland, UK*

**Abstract**

The future of mega infrastructure projects is certain - there will be more risks to manage! Finding the right approaches, tools and techniques for managing the dynamics of risks in megaprojects is both a challenge and an opportunity. The challenge is being met through research and innovation combining current approaches with new. How do we combine what we know with what we think to predict what to do when faced with scenarios that are both complex and difficult to predict than what we currently know? The challenges of the future are unlikely to be same as in the past or present. However, learning systems offer us holistic approaches to managing risks in megaprojects. This research adopted a dynamic approach through the combination of Analytical Network Process (ANP) and system dynamics (SD) as an innovative methodology known as SDANP to model complexity in megaprojects design and construction. We communicate how the SDANP model could explore problems caused by Social, Technical, Economic, Environmental and Political (STEEP) risks to construction cost, time and performance and provide insights that lead to organizational learning. We proceed to exemplify by means of a real-life case project in the City of Edinburgh and offer suggestions on what front-ended stakeholders could do to improve the management of risks in megaprojects. For researchers, the findings contribute to the project management theoretical development within the field of megaproject management. For practitioners, it challenges the paradigm of considering the new methodology as a successful risk assessment in megaprojects. The results of the application showed that, when compared to traditional risks assessment methods, this SD model with integrated ANP revealed improvements in managing risks according to STEEP risks criteria. The new framework appears to be a superior solution for solving the dynamic complexities of risks during megaproject design and construction.

**Keywords:** Analytical Network Process, Megaprojects, Risk complexity, System dynamics.

## 1. INTRODUCTION

This study presents a heuristics approach in prioritising and assessing risk complexity in megaproject construction and then tests the model on a transportation construction project. The model incorporates both tangibles like work-to-do, project cost and intangibles such as uncertainties, grievances, and inadequate project complexity analysis in the risk assessment process by using the Analytical Network Process (ANP) to prioritise risks and the system dynamics (SD) approach to simulate the dynamics of such risks overtime within the SDANP framework to increase the analytical

and the dynamic capabilities of traditional risk assessment methods. Most construction risk assessment models include analytical parameters such as cost, duration, quality, probabilities, etc., without incorporating heuristics. With regards to the increasingly complex and dynamics of megaprojects coupled with new procurements methods, the tendency today is to use risk quantification and modelling more as vehicles to promote effective risk response planning amongst multi-disciplinary project team members. (Davies *et al.* 2014) emphasised that, an effective risk management approach can provide a framework to identify and assess potential risks

so that response actions can be taken to mitigate them. However, many of the risk management approaches developed by contractors and their consultants are not dynamically enough to analyse and assess risk (Too and Too 2010). As a result, communicating construction project risks become poor, incomplete, and inconsistent throughout the construction supply chain.

Against this backdrop, the authors employed a combination of quasi-ethnography, interviews and the literature to identify different social, technical, economic, environmental and political (STEEP) risk factors that impacted on the performance of Edinburg Tram Network (ETN) project during construction. The identified factors were then prioritised using ANP to establish the most salient STEEP variables on the ETN project. The selected factors from the ANP were then modelled within SDANP framework to appraise their measured impact on the cost, time and quality performance of the project. The approach is to gain a fuller understanding of the interrelationships between the multiple variables in the system. Also, it is to demonstrate the potential benefits of the SDANP approach. The aim of the paper therefore, is to explore and model using the SDANP framework, problems caused by STEEP risks to construction cost, time and performance and provide insights that lead to organizational learning. The knowledge gain could be used to improve the accuracy of risks estimation, thereby reducing the problem of cost and time overruns during megaproject delivery. The objectives of this research are to:

- develop a framework that incorporates Social, Technical, Economic, Environmental and Political (STEEP) risks into a SDANP methodology for risks assessment in megaproject during construction and
- test the SDANP methodology on a transportation megaproject

For researchers, the findings would contribute to the project management theoretical development within the field of megaproject management. It will further provide an innovative framework that offers a platform to incorporate tangible and intangible risk variables into a risk assessing process using ANP for prioritising risks and SD for simulating those risks overtime. For practitioners, it challenges the paradigm of considering the new methodology as a successful risk assessment in megaprojects. When compared to traditional risks assessment methods, the results obtained from the integration of the ANP and SD methodology revealed improvements in managing risks according to STEEP risks criteria. The new framework appears to be a superior solution for solving the dynamic complexities of risks during megaproject design and construction.

## 1.1. LITERATURE REVIEW

The literature review is segmented in two main categories. This includes: (a) overview of the Analytical Network Process and (b) Current trend of SD applications in construction project management.

### 1.1.1. The Analytical Network Process (ANP)

The ANP is a methodological tool developed by Thomas Saaty. The tool is leveraged for this research because of its significance in multi-criteria decision making (MCDM) when an extensive number of factors are involved. The ANP is a more general form of the Analytic hierarchical Process (AHP) for ranking alternatives based on some set of criteria. Unlike AHP, ANP is capable of handling feedbacks and interdependencies, which exist, in complex systems like the STEEP risks system in megaproject development. ANP problem formulation starts by modelling the problem that depicts the dependence and influences of the factors involved to the goal or higher-level performance objective. The ANP as a methodology has a precise language regarding the components of the problem and the relationship between them. In Saaty (2005), the ANP was defined as a systematic approach which uses both the quantitative and qualitative factors for multiple criteria decisions. As a decision making tool, the ANP is made up of a network of criteria and alternatives (which are all called elements), grouped into clusters. These elements in the network can be related in any possible way to incorporate feedback and interdependent relationships within and between clusters. This provides a more natural approach for modelling complex environment, such that a more objective concept which leads to the most influential to the goals will be obtained. That is, in the context of this study, ANP offers a high flexibility for modelling and prioritizing risk.

ANP can break down more clearly the risk attributes, not limited to the probabilities, but also all possible potential consequences, in more specific criteria.

Since its development, the ANP has been successfully applied to solve a wide range of multi-criteria decision making problems. Some areas where ANP has been applied are: risk assessment and decision analysis (Ergu *et al.* 2014); location analysis (Yeh and Huang 2014); resource allocation (Liang and Wey 2013), outsourcing decision making (Tjader *et al.* 2014), evaluation (Lee *et al.* 2015) and for risk assessment (Chen *et al.* 2011). In addition, the ANP has been widely used in solving many other complicated decision problems. Azadnia *et al.* (2015) used ANP for environmental supplier selection for Hazardous Substance Management. Others include, a decision rule-based for financial forecasting in the banking sector (Shen and Tzeng 2014); evaluation of long term performances of production (Pourjavad and Shirouyehzad 2014); modelling risk based maintenance for chemical plants (Kumar and Maiti 2012) and for the supplier selection in the construction and civil engineering companies (Eshtehardian *et al.* 2013). Many other applications of ANP have also been discussed in various conferences and detailed literature review (Sipahi and Timor 2010, Lombardi *et al.* 2011).

### 1.1.2. Current Trend of SD Application in Construction

The System Dynamic (SD) is a field developed by Jay Forrester in mid 1950s. It is a

methodology used for modelling and analysing the behaviour of complex social systems in an industrial context (Sterman 2000). It was designed to help decision-makers learn about the structure and dynamics of complex systems. It is used to design high leverage policies for sustained improvement, and to catalyse successful implementation and change. SD has been used by researchers and project managers in many fields to understand various social, economic and environmental systems in a holistic view (Towill 1993, Rodrigues and Bowers 1996, Sycamore and Collofello 1999, Love *et al.* 2002, Mawby and Stupples 2002, Ogunlana *et al.* 2003, Williams *et al.* 2003). Sterman (1992) and Lyneis and Ford (2007) demonstrated SD capabilities in improving construction project management. Saeed and Brooke (1996) used SD to model how civil engineering contracts can be improved through dynamic reasoning. Love *et al.* (2000)

developed SD model to model design errors and rework in construction projects. Ogunlana *et al.* (2003) used SD to explore performance enhancement in a construction organisation. Park *et al.* (2004) offered a dynamic model for construction innovation. Nasirzadeh *et al* (2008) used SD to assess the impact of different risks on construction project objectives. Boateng *et al.* (2012) used SD to model the impacts of critical weather conditions on construction activities and further describe the approach of SD in assessing risks in megaproject during construction (Boateng *et al.* 2013).

## 2.0. METHODOLOGY

### 2.1. SDANP Framework

Figure 1 represents the overall flow of the proposed SDANP framework. It comprises of the Analytical Network Process (ANP) and the System Dynamics (SD) modelling. Brief explanation of the various interfaces of the framework is as follow:

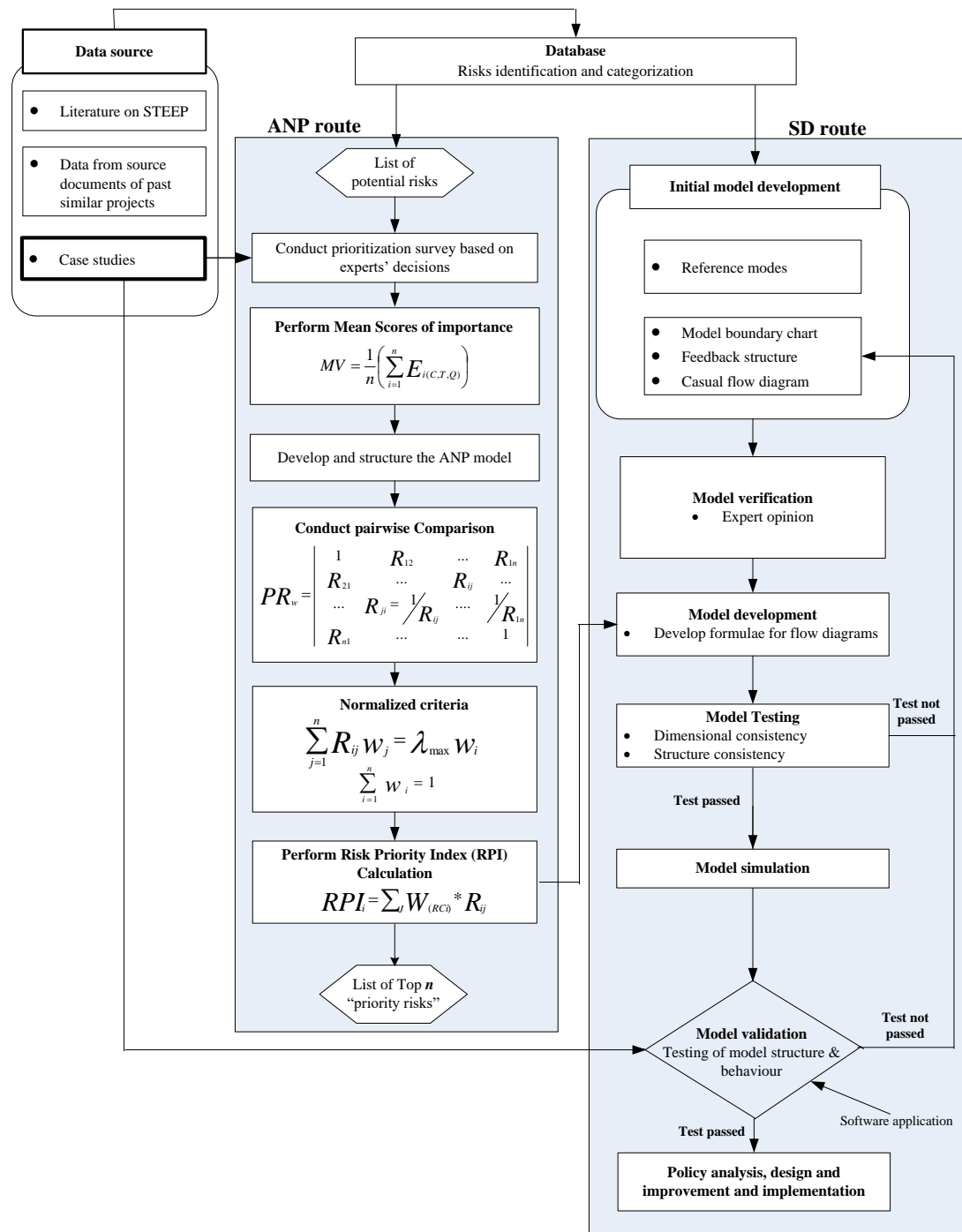**Figure 1**: The Proposed SDANP Framework for risk assessment (Boateng 2014)

**Data Source: -** This is the source from which data for project risks originate. The sources include the literature, documents of past and similar projects and case studies.

**The database: -** This is the channel used to categorize identified risks within the organization and to store information about projects. The information stored here is used to

facilitate the data transfer into both the ANP and the SD.

**The ANP Route:-**This route is composed of risk prioritization survey based on experts' decisions, the analytical network model development and the risk prioritization index calculation. The purpose of this route is to prioritize list of potential risks based on their relative importance in the organization. After risks are categorized, the ANP is first used to synthetize expert judgments into numerical values given their specific subjectivity inputs. The experts' decisions are the preset choices made by the experts based on the the risk prioritization survey for selecting potentially "high risks" using a Likert type scale of 1 to 5 to score the level of STEEP risks impact on megaproject objectives (cost, time and quality) in the construction phase. A weighted quantitative score (WQS) method is used to translate experts' decisions during prioritization surveys into synthetize numerical values to derive the mean scores of importance. The mean scores can be significantly distinguished based on participant's experience, background and as well as information in regard to a case study project by using Equation 1.

$$MV = \frac{1}{n}\left(\sum_{i=1}^{n} E_{i(C,T,Q)}\right) \tag{1}$$

Where

- **MV** indicates the value of mean scores of importance for each criteria/sub-criteria calculated by WQS.
- **E** refers to the experimental WQS for each sub/criteria expressed as a percentage

year of experience multiplied by each participant's score of importance.

- **i_c** is the participant's score of importance for each sub/criteria with respect to cost.
- **i_t** is the participant's score of importance for each sub/criteria with respect to time.
- **i_q** is the participant's score of importance for each sub/criteria with respect to quality.
- **n** is the total number of participants in this research.

Decisions made at the point of risk synthetisation can be subjected to adjustment due to changing priorities. Following the calculation of the mean score, the ANP models can then be developed based on experts' decisions into criteria, sub-criteria and options as indicted in figure 2.

The ANP Network Model for Risk Prioritization illustrate in Figure 2 consists of three clusters: 'Goal', 'Criterion' and 'Option.' Cluster 'Goal' contains only one element as the statement of the purpose for risk prioritization within which the category of 'High risks' are listed according to the results from the pairwise comparison calculation. Cluster 'Criterion' consists of potential consequences of elements of potential risks on project cost, time and quality. The cluster 'Options' contains potential risks and a list of their potential sub risk variables. The arrows indicate relationships between elements in one cluster against elements in other clusters. In cluster 'Criterion', there are inner dependencies which indicate that the elements in this cluster affect each other. The purpose of the ANP model is to categorize the decisions in a logical and

intuitive tree of hierarchy and to adapt to emerging changes. In ANP, pairwise comparisons of the elements in each level are conducted with respect to their relative importance to their control criterion. The correlation matrices are prepared on a 1-9 ratio scale presented in Table 1 to determine the relative preferences for two elements of the hierarchy in the matrix. A score of 1 indicates that the two options have equal importance whereas a score of 9 indicates dominance of the component under consideration over the comparison component matrices.
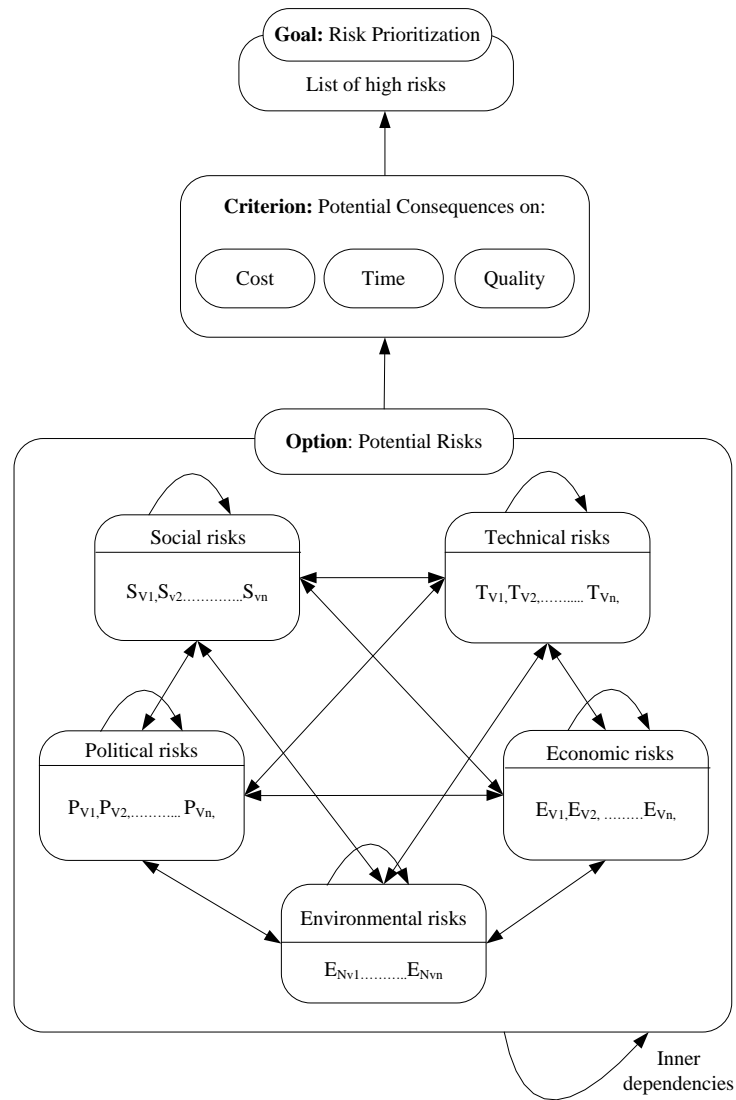


**Figure 2**: ANP Network Model for Risk Prioritization (Boateng 2014)

**Table 1**: Relative importance and data transformation in pairwise comparison

| Intensity of importance | Definition (Saaty 1996) | Data transformation mechanism (Chen et al. 2011) |
|---|---|---|
| 1 | Equal | 1:1 |
| 2 | Equally to moderately dominant | 2:1, 3:2, 4:3, 5:4, 6:5, 7:6, 8:7, 9:8 |
| 3 | Moderately dominant | 3:1, 4:2, 5:3, 6:4, 7:5, 8:6, 9:7 |
| 4 | Moderately to strongly dominant | 4:1, 5:2, 6:3, 7:4, 8:5, 9:6 |
| 5 | Strongly dominant | 5:1, 6:2, 7:3, 8:4, 9:5 |
| 6 | Strongly to very strongly dominant | 6:1, 7:2, 8:3, 9:4 |
| 7 | Very strongly dominant | 7:1, 8:2, 9:3 |
| 8 | Very strongly to extremely dominant | 8:1, 9:2 |
| 9 | Extremely dominant | 9:1 |

Source: (Boateng 2014)

Using Equation (2), the comparison matrix for each cluster can be performed. Let W = {Wj | j = 1, 2 ....... n} be the set of criteria. The result of the pairwise comparison on n criteria can be summarized in an (n x n) evaluation matrix PR in which every element Rij (i, j = 1, 2, ..., n) is the quotient of weights of the criteria. This pairwise comparison can be shown by a reciprocal matrix. That is, if activity i has one of the above non-zero numbers assigned to it when compared with activity j, then j has the reciprocal value when compared with i. The results of the comparisons are represented by dimensionless quotients to measure the preference of one option over the other. A direct numerical appreciation is not required from the decision maker, but rather a relative appreciation.  PR is the potential risks and Rij, the comparison between risk variables i and j.

$$PR = \left(R_{ij}\right)_{nxn} \begin{vmatrix} 1 & R_{12} & \cdots & R_{1n} \\ 1/R_{12} & 1 & R_{ij} & R_{2n} \\ \vdots & R_{ji=1}/R_{ij} & \ddots & \vdots \\ 1/R_{1n} & 1/R_{2n} & \cdots & 1 \end{vmatrix} \quad (2)$$

(2)

Once the pairwise comparison is completed for the whole network, the vector corresponding to the maximum eigenvalue of the constructed matrices is computed and a priority vector is obtained. The priority value of the concerned element is established by normalizing this vector as described in equation 3.

$$\sum_{j=1}^{n} R_{ij}w_i = \lambda_{max}w_i \qquad (3)$$

Where 'R' is the matrix of pairwise comparison, 'w' is the eigenvector, and '$\lambda_{max}$' is the maximum eigenvalue of [R]

By substitution, the maximum eigenvalue ($\lambda_{max}$) is calculated to derive a new matrix (W). The matrix (W) is then used to multiply comparison matrix (R) with ($w_i$) as indicates in Equation 4. Finally, the ($\lambda_{max}$) can be obtained

by averaging the values obtained from Equation 4. Computations of the process used to calculate the maximum eigenvalue ($\lambda_{max}$) is shown in Equation (5).

$$\begin{vmatrix} 1 & R_{12} & \cdots & R_{1n} \\ 1/R_{12} & 1 & R_{23} & R_{2n} \\ \vdots & 1/R_{23} & \ddots & \vdots \\ 1/R_{1n} & 1/R_{2n} & \cdots & 1 \end{vmatrix} \times \begin{vmatrix} w_1 \\ w_2 \\ \vdots \\ w_n \end{vmatrix} = \begin{vmatrix} W_1 \\ W_2 \\ \vdots \\ W_n \end{vmatrix} \qquad (4)$$

$$\lambda_{max} = \frac{1}{n}\left(\frac{W_1}{w_1} + \frac{W_2}{w_2} + \ldots\ldots + \frac{W_n}{w_n}\right) \qquad (5)$$

During the risk assessment process, a problem may occur in the consistency of the pairwise comparisons. The consistency ratio is used to check the consistency of the calculation and to provide a numerical assessment of the process. If the calculated ratio is less than 0.10, consistency is considered to be satisfactory. The conceptual model is then imported into a Super Decision Software to perform the pairwise comparison. The aim of constructing pairwise matrices is to derive the relative weight of each potential risk. Finally, the risk prioritization index (RPI) is calculated using equation 6 to support final decision making. The criterion to make this selection is the weights of alternatives that can be taken from a synthesised super-matrix derived from the Super Decision Software. Although the RPI can be performed manually with the equation 6, it was performed by the Super Decisions Software in this study. Computation priorities

command was used to determine the priorities of all the nodes in the network

$$RPI_i = \sum_i W_{(C,T,Q)} * R_{ij} \qquad (6)$$

Where 'RPI$_j$' represents the global priority of the risk options i, 'W$_j$,' the weight of the criterion j with respect to project cost, time and quality, and 'R$_{ij}$', the local priority

After the priority computation, the RPIs can be classified into five states of likelihood and consequence on project cost, time and quality so that a five-by five matrices can be against each risk as either "very high", "high", "moderate", "low" or "very low". The risk prioritization index (RPI) calculation is the platform where the analytical framework is combined with the experts' decisions to produce independent assessments on project priorities without further input from the experts. Finally, the results obtained from the RPI calculation can be listed as the 'n' priority risks for further decision making.

**The SD Route:-**While the ANP's pairwise comparison is being performed, an initial SD model can be developed using information from the database.   The concept is to understand how the parts in a system interact with one another. Also, it is to show how a change in one variable can affect the other over time and in turn affects the original variable (See Figure 3).
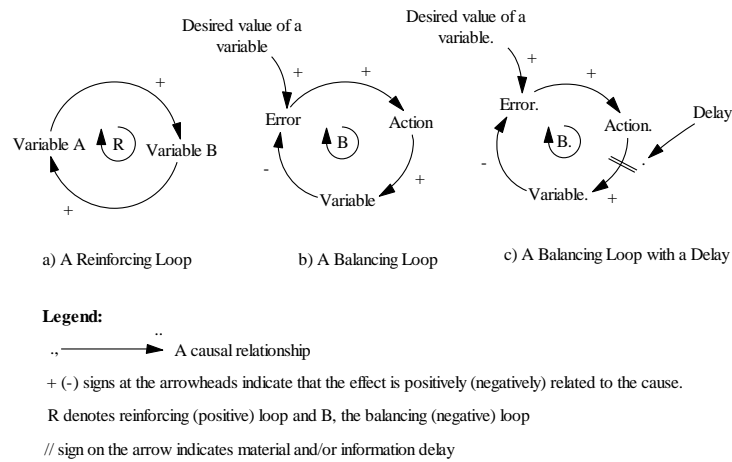
**Figure 3**: The Three Components of System Dynamics Models.

SD can be used to model systems in both qualitative and quantitative manner. SD models can be constructed from three basic building blocks: positive feedback or reinforcing loops, negative feedback or balancing loops, and delays. Positive loops (called reinforcing loops) are self-reinforcing while negative loops (called balancing loops) tend to counteract change. Delays in SD models indicate potential instability in the system. Figure 3a shows how a reinforcing loop feeds on itself to produce a growth in a system to correspond to positive feedback loops in control theory. For example, in Figure 3a, an increase in variable (A) leads to an increase in variable (B) (as indicated by the "+" sign) and that in turn leads to additional increase in variable (A) and so on. The "+" sign indicates on the head of the arrow does not necessarily mean that the values produced in the system will increase. It is just that variable (A) and variable (B) will change in the same direction of polarity. If variable (A) decreases, then variable (B) will decrease. In the absence of external influences, both variable (A) and variable (B) will clearly grow or decline exponentially. Reinforcing loops generate growth, amplify deviations, and reinforce change. A balancing loop indicated in Figure 3b is a structure that changes the current value of a system variable or a desired or reference variable through some action. It corresponds to a negative feedback loop in control theory. A (-) sign indicates that the values of the variables change in opposite directions. The difference between the current value and the desired value is perceived as an error. An action proportional to the error is taken to decrease the error so that, over time, the current value approaches the desired value. The third basic element is a delay, which is used to model the time that elapses between cause and effect. A delay is indicated by a double line, as shown in Figure 3c. Delays make it difficult to link cause and effect (dynamic complexity) and may result in unstable system behaviour. Based on a verified Causal Loop Diagram, a stock and flow diagram indicated in figure 4 can be developed using the 'n' priority risks derived from the ANP computation and the inputs which the experts provided to facilitate

in-depth stock and flow modelling and risk simulation overtime.

The governing equations used to calculate the entire system parameters can also be formulated at this point. To understand accumulation process of inflow of uncertainties, it is important to know the mathematical meaning used to integrate the flow of risk influences into the system. Based on

a mathematical definition of the integral, the level of risk impacts inside a stock will be the integration of total flows of uncertainties on the stock (See equation 7).

$$\text{Stock (t)} = \int_0^t [\text{flows}_{total}\,(s)]ds \qquad (7)$$

Where $\int_0^t [\text{flows}_{total}\,(s)$ *is a function of the total flow in the system.*
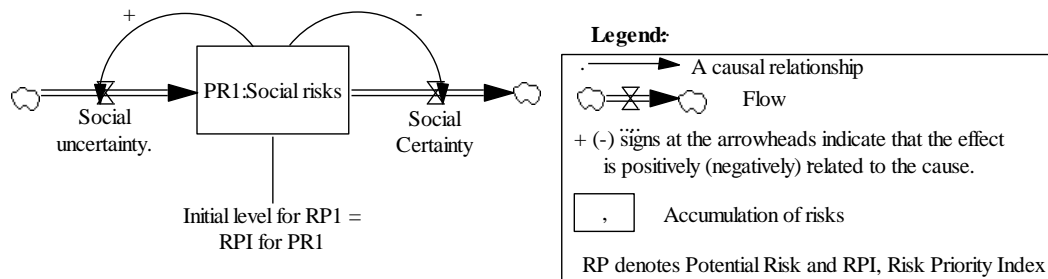


**Figure 4**: A simple Stock and Flow Model

Inflow (Uncertainty) indicates the increasing amount of risk level in the stock (Risk accumulation container). In the other hand, outflow (certainty) decreases the level of risk impacts in the stock. Using ANP's RPI as the quantity of risk impact level in the stock at the initial time, the equation above becomes the following:

$$\text{Stock (t)} = \int_0^t [\text{flows}_{total}\,(s) - \text{Outflow}(s)]ds + \text{Stock}(0) \qquad (8)$$

*Where Stock(0) is the stock of risk impact level (RPI) at the initial time, (t = 0).*

In Systems Dynamics, verbal descriptions and causal loop diagrams are more qualitative; stock and flow diagrams and as well as model equations are more of quantitative ways to describe a dynamic situation. Since Systems

Dynamics is largely based on the soft systems thinking, (learning paradigm), it is well suited to be applied on those managerial problems which are ambiguous and require better conceptualization and insight (Madachy 2007).

## 2.2. Test of the SDANP for Dynamic Risk Management

The proposed SDANP methodology was subjected to a case study to measure its effectiveness in performing dynamic risk assessment in megaproject construction. The case study project is ETN project. It consisted initially of three lines and was designed to run through the City Centre of Edinburgh. The construction involved new bridges, retaining walls, viaducts, the tram depot and control centre, electrical sub stations to provide power

to the overhead lines at 750 volts, track laying and tram stops. The initial contract value was £545 million, with a contract period of 3 years. The project was procured using a turnkey contract. The client (City of Edinburgh Council aka CEC) used a private limited company known as Transport Initiatives Edinburgh (TIE) to deliver the tram system. Until August 2011, ETN project was overseen by TIE (a company wholly owned by CEC) and was responsible for project-managing the construction of the tramway. Further role of TIE was to administer, integrate and coordinate the consultants and principal contractor (a consortium of Bilfinger Berger and Siemens) involved in the project. By February 2011, contractual disputes and further utility diversion works resulted in significant delays to the project beyond the originally planned programme. In late 2011, TIE was released from managing the ETN Project. Turner and Townsend (T&T), a project management consultant was brought in by Also, the outputs indicated on Table 4 revealed the dynamic simulation results under the following time bounds and units of measurements for system variables:

i. *The initial time for the simulation = 2008, Units: Year*

ii. *The final time for the simulation= 2015, Units: Year*

iii. *The time step for the simulation = 0.125, Units: Year*

iv. *Unit of measurement for system variables = Dimensionless*

CEC to ensure effective oversight and delivery of the project. Work in 2012 continued smoothly on schedule with a new governance structure under the management of T&T until the project was completed in summer 2014.

**3.0. RESULTS AND DISCUSSION**

In SDANP simulation, trend analysis is given priority and numbers do not have much significance, however, the numbers should be, as far as possible, close to the real life situations. In the context of the STEEP risks modelling, the ANP input to the system to conduct simulation is represented in Table 3.

**Table 3**: Summary of the ANP Inputs

| Code | System Variables | ANP Inputs (%) |
|---|---|---|
| $P_{R1}$ | Social | 0.13 |
| $P_{R2}$ | Technical | 0.30 |
| $P_{R3}$ | Economic | 0.25 |
| $P_{R4}$ | Environmental | 0.16 |

It can be observed on Table 4 and Figure 5 that project time and cost are all impacted by STEEP risks. The mean impact levels of all risks in succession from $P_{R1}$ to $P_{R5}$ on ETN project is revealed to be 19%, 40.48%, 21.50%, 14.86% and 35.20%. Time was the most sensitive to the impact of economic, environmental and political risks whilst cost was sensitive to the impact of the economic, environmental, political and social risks. On the other hand, project quality was sensitive to the economic, environmental and political risks.

**Table 4**: Summary of the Dynamic Simulation Outputs

| | | Expected Level of Risk in the project (%) | | | | | |
|---|---|---|---|---|---|---|---|
| | | *Min* | *Max* | *Mean* | *Median* | *StDev* | *Norm* |
| $P_{R1}$ | Social risks | -31.00 | 48.00 | 19.00 | 20.00 | 18.00 | 96.00 |
| $P_{R2}$ | Technical risks | 30.00 | 55.69 | 40.48 | 39.28 | 7.41 | 18.31 |
| $P_{R3}$ | Economic risks | 1.72 | 33.0 | 21.51 | 26.07 | 10.73 | 49.86 |
| $P_{R4}$ | Environmental risks | 6.59 | 18.78 | 14.86 | 14.86 | 16.39 | 3.85 |
| $P_{R5}$ | Political risks | 17.0 | 42.1 | 35.2 | 37.7 | 7.04 | 20.0 |
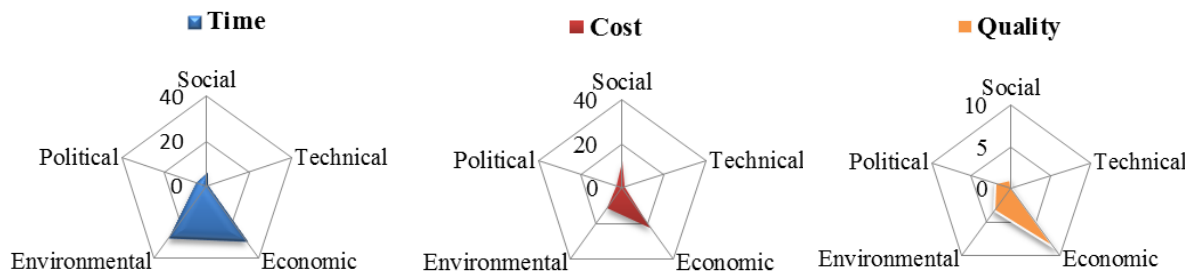


**Figure 5**: Measured Impact of STEEP Risks

### 3.1 SDANP Model Validation

For practical reasons, empirical tests were conducted to examine the ability of the STEEP model to match the historical data of the case study project. Information gathered from the real system was compared to the simulated results. As Table 5 indicates, the total level of risks impacted on the ETN project which resulted to cost and time overruns and project quality deficiency is 49.53% on cost, 71.61% on time and 15.33% quality. Prior to the dynamic simulation, the planned budget for the project was £545 million and was expected to be completed in 3 year. Later, the planned budget of the project was revised to £776 million and that of the planned completion time to 6 years. After simulation was performed, the result was validated against the real system to reveal the actual STEEP risks implication on the project performance. The validation results revealed that the actual project cost was overrun by £270.266 million while the project completion time also was exceeded by a 2.148 years as compared to the original project cost and time variations of £231 million and 3 years respectively.

**Table 5**: Data Validity on Edinburgh Tram Network Project

| Original Project Information (OPI) | | |
|---|---|---|
| Cost (£ Million) | Planned Project Budget (PPB) | 545 |
| | Revised Project Budget (RPB) | 776 |
| | Project Cost Variation (PCV) | 231 |
| Year of Completion | Original Planned Date (OPD) | 2011 (3 Years) |
| | Expected New Date (END) | 2014 (6 Years) |
| | Completion Date Variation (CDV) | 3 Years |

| ANP/SD Simulation Project Information (SPI) | | | Validated Project Information | |
|---|---|---|---|---|
| Risks | Level of Risk Impact on Project Performance –LRIPP (%) | | (OPI X SPI) | |
| | Cost (C) $(SPI_C)$ | Time (T) $(SPI_T)$ | Quality (Q) $(SPI_Q)$ | Cost (£ million) $\{(SPI_C) \times (PPB)\}$ | Time (year) $\{(SPI_T) \times (OPD)\}$ |
| Social | 12 | 6 | 1 | 65.4 | 0.18 |
| Technical | 1.24 | 0.43 | 0.15 | 6.758 | 0.013 |
| Economic | 22.36 | 30.74 | 8.88 | 121.862 | 0.922 |
| Environmental | 11.43 | 29.3 | 3.35 | 62.294 | 0.879 |
| Political | 2.56 | 5.14 | 1.95 | 13.952 | 0.154 |
| Total Impact | **49.59** | **71.61** | **15.33** | **270.266** | **2.148** |

Boateng (2014)

The simulation results further revealed that the quality of ETN project was impacted by 15.33%. However, there was no available historical data on the original level of project quality deficiency to be validated against with this output. Hence, the hypothesized system which was initially made up by expert's knowledge was used to compare the real system. This was the case so that a better presentation of the real system with the model system can be experimented to achieve a higher degree of confidence in the SDANP model. Examples of expert knowledge calibration techniques used are meetings with academic staff, some members of European Cooperation in Science and Technology (E-COST) in charge of scientific research in megaproject effective delivery, industrial stakeholders and as well as the use of the ANP application.

**4.0. CONCLUSIONS**

To reduce risks, front-end stakeholders involve in megaproject development can use the new generic tool for risk management in five steps: risk management planning, risk identification, qualitative and quantitative risk analysis, risk response planning, risk monitoring and control.

**Step 1: Risk management planning-** Within the STEEP risk management planning,

feedback loops concerning project risks can be used by planners to pro-actively test and improve the existing project plan such as forecasting and diagnosing the likely outcomes of the current plan.

**Step 2: Risk identification-**The SDANP models can support risk identification in a qualitative level through the causal loop diagrams. Given STEEP as specific risks, it is possible to identify which feedback loops favour or counter the occurrences of such risks so that the direct or indirect impacts of the project magnitude can be understood.

**Step 3: Risk analysis-**The causal loop models can further assist project managers in assessing all risks in both qualitative and quantitative manners.  In the qualitative analysis, each feedback loop can be a dynamic force that pushes away from the risk occurrence. With regards to risk likelihood, magnitude and impacts, a simulation model can be used to identify and capture the full impacts of potential risks on the project. Further impacts of risks can be quantified and simulated to generate a wide range of estimates and scenarios to reflect the full impacts of the risks occurrences and impacts on megaprojects during construction.

**Step 4: Risk response planning**- The models can be effectively used to support risk response planning in megaproject development in three ways.

– Provide a feedback perspective for risk identification

– Provide a better understanding of the multiple- factor causes of risks and a trace

through the chain to identify further causes and effects.

– Serve as powerful tools to support project managers to devise effective responses.

**Step 5: Risk monitoring and control-** The models provide effective tools for risk monitoring and control. Through the cause and effects diagrams, early signs of unperceived risk emergence can be identified to avoid aggravation. In addition, simulated models can provide an effective monitoring and control mechanism for risk diagnosis.

Based on the above reasons, it would therefore be more appropriate to assess risks in megaprojects during construction with the SDANP framework so that every project management team member at the decision level can benefit from the knowledge that went into making these decisions before arriving at the final level of risk implications on the megaproject objectives throughout the project schedule time. The goal of the SDANP risk assessment approach is not to eliminate all risks from the project. Rather, it is to recognize the significant risk challenges and the complexities of those challenges on the project performance overtime so that an appropriate management responses can be initiated to mitigate those challenges.

**REFERENCES**

Azadnia, A H, Saman, M Z M and Wong, K Y (2015) Sustainable supplier selection and order lot-sizing: An integrated multi-objective decision-making process. *International Journal of Production Research*, **53**(2), 383-408.

Boateng, P (2014) *A dynamic systems approach to risk assessment in megaprojects*, Royal Academy of Engineering Centre of Excellence in Sustainable Building Design, School of the Built Environment, Heriot-Watt University, UK.

Boateng, P, Chen, Z and Ogunlana, S (2012) A conceptual system dynamic model to describe the impacts of critical weather conditions in megaproject construction. *Journal of Construction Project Management and Innovation*, **2**(1), 208-24.

Boateng, P, Chen, Z, Ogunlana, S and Ikediashi, D (2013) A system dynamics approach to risks description in megaprojects development. *Organization, Technology & Management in Construction: An International Journal*, **4**(Special Issue), 0-.

Chen, Z, Li, H, Ren, H, Xu, Q and Hong, J (2011) A total environmental risk assessment model for international hub airports. *International Journal of Project Management*, **29**(7), 856-66.

Davies, A, MacAulay, S, DeBarro, T and Thurston, M (2014) Making innovation happen in a megaproject: London's crossrail suburban railway system. *Project Management Journal*, **45**(6), 25-37.

Ergu, D, Kou, G, Shi, Y and Shi, Y (2014) Analytic network process in risk assessment and decision analysis. *Computers & Operations Research*, **42**(0), 58-74.

Eshtehardian, E, Ghodousi, P and Bejanpour, A (2013) Using anp and ahp for the supplier selection in the construction and civil engineering companies; case study of iranian company. *KSCE Journal of Civil Engineering*, **17**(2), 262-70.

Kumar, G and Maiti, J (2012) Modeling risk based maintenance using fuzzy analytic network process. *Expert Systems with Applications*, **39**(11), 9946-54.

Lee, S, Geum, Y, Lee, S and Park, Y (2015) Evaluating new concepts of pss based on the customer value: Application of anp and niche theory. *Expert Systems with Applications*, **42**(9), 4556-66.

Liang, S and Wey, W-M (2013) Resource allocation and uncertainty in transportation infrastructure planning: A study of highway improvement program in taiwan. *Habitat International*, **39**(0), 128-36.

Lombardi, P, Giordano, S, Farouh, H and Yousef, W (2011) An analytic network model for smart cities. *In*, *Proceedings of the International Symposium on Analytic Hierarchy Process*, 1-6.

Love, P E, Mandal, P, Smith, J and Li, H (2000) Modelling the dynamics of design error induced rework in construction. *Construction Management & Economics*, **18**(5), 567-74.

Love, P E D, Holt, G D, Shen, L Y, Li, H and Irani, Z (2002) Using systems dynamics to better understand change and rework in construction project management systems. *International Journal of Project Management*, **20**(6), 425-36.

Lyneis, J M and Ford, D N (2007) System dynamics applied to project management: A survey, assessment, and directions for future research. *System Dynamics Review*, **23**(2-3), 157-89.

Madachy, R J (2007) *Software process dynamics.* John Wiley & Sons.

Mawby, D and Stupples, D (2002) Systems thinking for managing projects. *In, Engineering Management Conference, 2002. IEMC '02. 2002 IEEE International*, 2002, Vol. 1, 344-9 vol.1.

Nasirzadeh, F, Afshar, A, Khanzadi, M and Howick, S (2008) Integrating system dynamics and fuzzy logic modelling for construction risk management. *Construction Management and Economics*, **26**(11), 1197-212.

Ogunlana, S O, Li, H and Sukhera, F (2003) System dynamics approach to exploring performance enhancement in a construction organization. *Journal of Construction Engineering and Management*, **129**(5), 528-36.

Park, M a P-M, F. (2004) Reliability buffering for construction projects. *Journal of Construction Engineering and Management*, **130**(5), 626-37.

Pourjavad, E and Shirouyehzad, H (2014) Evaluating manufacturing systems by fuzzy anp: A case study. *International Journal of Applied Management Science*, **6**(1), 65-83.

Rodrigues, A and Bowers, J (1996) The role of system dynamics in project management. *International Journal of Project Management*, **14**(4), 213-20.

Saaty, T L (1996) *Decision making with dependence and feedback: The analytic network process.* Vol. 4922, RWS publications Pittsburgh.

Saaty, T L (2005) Theory and applications of the analytic network process: Decision making with benefits, opportunities, costs,

and risks. Pittsburgh. *Pennsylvania: RWS Publications.*

Saeed, K and Brooke, K (1996) Contract design for profitability in macro-engineering projects. *System Dynamics Review*, **12**(3), 235-46.

Shen, K-Y and Tzeng, G-H (2014) A decision rule-based soft computing model for supporting financial performance improvement of the banking industry. *Soft Computing*, 1-16.

Sipahi, S and Timor, M (2010) The analytic hierarchy process and analytic network process: An overview of applications. *Management Decision*, **48**(5), 775-808.

Sterman, J D (1992) System dynamics modeling for project management. *Unpublished manuscript, Cambridge, MA.*

Sterman, J D (2000) *Business dynamics: Systems thinking and modeling for a complex world.* Chicago, IL: Irwin/McGraw Hill.

Sycamore, D and Collofello, J S (1999) Using system dynamics modeling to manage projects. *In, Computer Software and Applications Conference, 1999. COMPSAC '99. Proceedings. The Twenty-Third Annual International*, 1999, 213-7.

Tjader, Y, May, J H, Shang, J, Vargas, L G and Gao, N (2014) Firm-level outsourcing decision making: A balanced scorecard-based analytic network process model. *International Journal of Production Economics*, **147, Part C**(0), 614-23.

Too, E and Too, L (2010) Strategic infrastructure asset management: A conceptual framework to identify capabilities. *Journal of Corporate Real Estate*, **12**(3), 196-208.

Towill, D R (1993) System dynamics-background, methodology and applications. 1. Background and methodology. *Computing & Control Engineering Journal*, **4**(5), 201-8.

Williams, T, Ackermann, F and Eden, C (2003) Structuring a delay and disruption claim: An application of cause-mapping and system dynamics. *European Journal of Operational Research*, **148**(1), 192-204.

Yeh, T-M and Huang, Y-L (2014) Factors in determining wind farm location: Integrating gqm, fuzzy dematel, and anp. *Renewable Energy*, **66**(0), 159-69.

**Assessing the Impact of Personality Traits on Academic Performance: Evidence from Tertiary Students in Ghana.**

**Edward Markwei Martey[1], Kwabena Aborakwa-Larbi[2], Edward Asante[3]**
[1&2]Marketing Department, Koforidua Polytechnic, Ghana.
[3]Library Department, Koforidua Polytechnic, Ghana.
**Email:** edmarkwei@yahoo.com

**Abstract**

The purpose of this study is to assess and predict the impact of personality traits on academic performance evidence from Tertiary students in Ghana. The main objective is to investigate the association between the personal traits ;( extraversion, neuroticism, openness to experience, agreeableness and conscientiousness) and academic performance. The target population of the study comprised of students who have studied a minimum of three semesters at selected tertiary institutions in Ghana.627 out of the 700 participants returned their questionnaires. Respondents were recruited from, Greater Accra Region of Ghana. The study adopted purposive sampling technique to select the tertiary institution whereas convenience sampling techniques were employed to select the students. With the aid of SPSS the following statistics were used: descriptive statistics in order to have a clear picture of study variables, Cranach's alpha to measure the internal consistency of the construct, Kurtosis and Skewness values to check the normality of each variable used and regression analysis to measure the effect of independent variables on dependent variables. The findings revealed that, there is a significant positive relationship between the academic achievements of tertiary student's that are conscientious, agreeable and openness, however extroversion and neuroticism failed to pass the hypothesis test. The research suggests that counsel periods should be organized by parents, lecturers and counselors regarding positive influence agreeableness at home, institutions and workplace and in the society for peaceful co-existence.

## 1.0 INTRODUCTION

Many scholars of pedagogy in much tertiary education have focused on teaching and learning techniques to deal with the unique needs of individual students. Appreciating individual differences, academic performance is essential to meeting the needs of today's diverse student population. Being abreast with the factors that affects student's academic performance has critical implication for tertiary education in relation to customizing teaching techniques to students, learning styles and curriculum design.

 Even though research has proved that cognitive ability is one most important determinate of academic successes (Poropat, 2009), contrary, according to Chamorro-Premuzic and Furnham,(2006) Furnham, Chamorro-Premuzic, &McDougall,(2003) there are other factors, aside cognitive ability that account for the variation evident in tertiary students' academic performance(s). The reason being that cognitive ability reflect what a student can do, whereas personality traits may reflect what a student will do (Furnham &Chamorro-Premuzic, 2004; Ackerman, , & Heggestad, . 1997), many researchers have expressed interest on how personality traits relates to academic success.

Since McCrae and Costa (1999) first proposed the Big Five model, it has appeared prominently in many studies on educational

performance. Studies mentioned shows that academic successes among tertiary students are significantly related with two of the Big Five traits: conscientiousness and openness to experience (Poropat, 2009; Trapmann et al., 2007; ).

## 1.11 The Big Five personal traits

The Big Five traits (extraversion, agreeableness, conscientiousness, neuroticism, and openness) have been related to a wide range of behaviors (McCrae and Costa (1999) including job performance, academic achievement, leadership and well-being (Heckman, et al. 2006; Judge, Jackson, Shaw, Scott, and Rich, 2007, Fairweather, 2012;).

## 1.1.2 Extraversion (ES)

Extraversion is regarded as a general tendency toward sociability, assertiveness, activeness and being talkative. Thus it is the degree to which a person is sociable, leader like and assertive as opposed to withdrawn, quiet and reserved. Individuals willing to entertain novel ideas and unconventional values are described by the openness to experience trait (Uziel, 2006).

## 1.1.3 Neuroticism (NM)

Kumari (2014) defined Neuroticism as a general tendency to experience negative effects such as fear, sadness, embarrassment, anger, guilt, and distrust. It is the degree to which a person is calm and self-confident as opposed to anxious and insecure.

## 1.1.4 Openness to Experience (OE).

Openness to Experience refers to individuals who tend to be creative, imaginative, and curious to experience new things amongst other things (Costa & McCrae, 1992). Openness to experience includes traits like imaginative, cultured, curious, original, broad minded, intelligent and artistically sensitive (Barrick & Mount, 2001).

## 1.1.5 Agreeableness (AG)

Agreeableness encapsulates constructs of sympathy, cooperativeness, and helpfulness towards others. It is described as the degree to which a person is good natured, warm and co-operative as opposed to irritable, uncooperative, inflexible, unpleasant and disagreeable (Noftle & Robins,2007)

## 1.1.6 Conscientiousness (CN)

.Conscientiousness is the trait that is associated with diligence, self-discipline, punctuality, and general competence (McCrae & Costa, 2003). Conscientiousness is the personality dimension that correlates the strongest, out of all personality dimensions, with overall academic performance (Barrick et al., 2001; Hurtz & Donovan, 2000).

## 1.1.7 Academic performance

Academic performance are not tangible and are difficult to measure because they result in the form of transformation of knowledge, life skills and behavior modifications of learners (Tsinidou, Gerogiannis, & Fitsilis, 2010). According to Galiher (2006) and Darling (2005) GPA measure student performance for the particular semester. Hijazi and Naqvi, (2006) used test results or previous year to measure academic performance for the specific subject or year.

### 1.1.8 Relationship between temperament and academic achievement

Poropat (2009) concluded that agreeableness, conscientiousness and openness to experience contribute to academic performance. Trapman's meta-analysis added neuroticism as a negative predictor of performance (Trapmann et al., 2007).Besides, a study of Iranian university students shows that neuroticism and extraversion are also significant predictors and both of them are negative (Hakimi et al., 2011).

### 1.2 Problem of the study

Many scholars and researchers for past decades of years have been constantly conducting research to find out among the parsimonious set of variables of personality traits which  has relationship with academic performance.( Trapmann et al., 2007; Poropat 2009; Hakimi et al., 2011) .Early researchers concluded that a trait has a relationship with academic performance; and that it is not a mere assistant of intelligence in determining the academic performance. This research on role of personality traits with regards to academic performance is to gives answer to the question why some individuals are academically inclined and others are not in spite having same intelligence level.

### 1.3 Objectives of the study

The purpose of this study is to investigate the relationship between the construct of personality traits on academic performance. The specific research objectives of the study are;

- To assess the relationship between extraversion and academic performance.
- To evaluate the relationship between neuroticism and academic performance
- To identify the relationship between openness affects and academic performance.
- To assess the relationship between agreeableness and academic performance.
- To evaluate the relationship between conscientiousness and academic performance

### 1.4 Hypotheses of the study

**H1**: Is there a relationship between Extraversion and academic performance

**H2**: Is there association between Neuroticism and academic performance

**H3**: Is there a relationship between Openness and academic performance.

**H4**: Is there a relationship between Agreeableness and academic performance

**H5**: Is there a relationship between Conscientiousness and academic performance

### 1.5 Limitations of the study

The decision about the size of the sample was taken considering time and cost, the need of precision and a variety of further considerations. Due to the limit of time and costs, the population was narrowed to tertiary students in Greater Accra Region alone. The sample was determined by convinces sampling. The construct of personal traits was narrowed to only five variables.

## 2.0 METHODOLOGY

Both primary and secondary data were used in the study. The study adopted purposive sampling technique to select tertiary institution whereas convenience sampling techniques was employed to select students.

### 2.1 Participants

The target population comprised tertiary students, both sexes between the ages of 18 and 40 who have at least three semester result from Methodist University College (MUC), University of Professional Studies (UPSA), Accra Polytechnic (A Poly) and Ghana Institute of Journalism (GIJ), all in the Greater Accra Region of Ghana. A sample of 627 participants returned the questionnaires out of 300 questionnaires sent out.

### 2.2 Data collection and Data analysis

Data were collected through the use of questionnaire. The questionnaire was divided into five sections. Section A elicited general and biographical information about respondents. Section B elicited information on Agreeableness. Section C sought information on Openness. Questions in Section D solicited information on Extraversion. Section E sought information on Neuroticism. Question in Section F captures information on Conscientiousness. Section G solicited information on academic performance. Likert scales anchored by strongly disagree (1) to strongly agree (5) were used in the questionnaire.

Once the data is collected and entered to computer using SPSS. The following statistics were used: descriptive statistics in order to have clear picture of study variables. Cranach's alpha, which measures the internal consistency of a construct, Kurtosis and Skewness values were used to check the normality of each variable used in the research. Regression analysis was used to measure the effect of independent variable on dependent variable.

## 3.0 RESULT

Following the guidelines indicated in the research methodology section, the researcher collected data in 2015.

Demographic information

**Table 1.** Demographic information

| Variables | Frequency | Percentage |
|---|---|---|
| Female | 381 | 60.8 |
| Male | 246 | 39.2 |
| Total | 627 | 100 |
| Age | | |
| 18-22 | 237 | 37.8 |
| 23- 27 | 249 | 39.8 |
| 28-32 | 141 | 22.4 |
| Total | 627 | 100.0 |
| Tertiary Institute | | |
| MUC | 168 | 26.8 |
| GIJ | 147 | 23.5 |
| A POLY | 123 | 19.6 |
| UPSA | 189 | 30.1 |
| Total | 627 | 100.0 |

| No. of semesters with institute | | |
|---|---|---|
| 3 semesters | 279 | 44.5 |
| Between 4 to 6 | 168 | 26.8 |
| Between 7 to 8 | 180 | 28.7 |
| Total | 627 | 100 |

**Survey results, 2015**

A detailed demographic analysis of respondents is presented in **Table 3.** Questionnaires were distributed to students who had been with their respective institution for at least 3 semesters. 627 completed questionnaires were collected from the respondents. Among the sample data 60.8% respondents are female whiles 39.2 are male. Besides, the modal age is between 23 – 27years representing 39.8% Also the respondents from USPA recorded the highest respondent at 30.1%.In relation to number of semesters' in respective institution 3 semester recorded the highest at 44.5% of the respondents.

**Table 4:** Values of Cronbach's alpha for the research construct

| Construct | Cranach's alpha |
|---|---|
| Extraversion (ES) | 0,758 |
| Neuroticism (NM) | 0,757 |
| Openness to Experience (OE) | 0,776 |
| Agreeableness (AG) | 0.767 |
| Conscientiousness (CN) | 0.756 |
| Academic performance (AP) | 0.778 |

(Source field work, 2015)

**Table 2.** Supporting literature for measurement scales.

| Construct supporting literature | |
|---|---|
| Academic performance | 110 |
| Extraversion (ES) | 223 |
| Neuroticism (NM) | 197 |
| Openness to Experience (OE) | 134 |
| Agreeableness (AG) | 202 |
| Conscientiousness (CN) | 24 |

(Source field work, 2015)

All of the measurement scales used, as shown in **Table 2,** were based on previous research. Assuring the validity and reliability of the measures required supporting literature to validate the scales which were used to operationalise the research constructs. The Big Five Traits construct was measured using the scales and indices included in the work of Ozer and Benet-Martinez (2006) who used the following variables to determine level of personal traits: Extraversion, Neuroticism, Openness to experience, Agreeableness and Conscientiousness.

**Table 3.** Values of Cronbach's alpha for the research constructs.

| Construct | |
|---|---|
| | Value |
| Academic performance | 110 |
| Extraversion (ES) | 223 |
| Neuroticism (NM) | 197 |
| Openness to Experience (OE) | 134 |
| Agreeableness (AG) | 202 |
| Conscientiousness (CN) | 24 |

**(Source field work, 2015)**

A reliability test was carried out using Cronbach's alpha, which measures the internal consistency of a construct. The recommended minimum acceptable limit of reliability for this measure, as reported by Sekaran (2003) is 0.60. As shown in **Table 3**, all the constructs passed the reliability test.

**Table 4. Descending means of the competitive priorities.**

| Construct | Mean | Standard deviation |
|---|---|---|
| Extraversion | 110 | 103 |
| Neuroticism | 223 | 214 |
| openness to experience | 197 | 120 |
| agreeableness | 134 | 121 |
| Conscientiousness. | 202 | 210 |

**(Source field work, 2015)**

The respondents indicated that their students exhibit different personal traits construct. It may be noted that each of the personality traits constructs shown in **Table 4** has a mean above 3. So it may be concluded that all of personality traits constructs are of considerable importance in the study.

**Table 5.** Skewness and Kurtosis for research constructs.

| Construct | skewness | Kurtosis |
|---|---|---|
| Academic performance | 110 | 103 |
| Extraversion | 223 | 214 |
| Neuroticism | 197 | 120 |
| openness to experience | 134 | 121 |
| Agreeableness | 202 | 210 |
| Conscientiousness. | 113 | 201 |

**(Source field work, 2015)**

As shown in **Table 5**, Kurtosis and Skewness values were used to check the normality of each variable included in the research. Skewness values larger than (+1) or smaller than (−1), as suggested by Sakan (2003) indicate a substantially skewed distribution. On the other hand,added that a curve is too peaked when the Kurtosis exceeds (+3) and is too flat when it is below (−3). Thus, Skewness values within the range of (−1) to (+1) and Kurtosis values within the range of (−3) to (+3) indicate an acceptable range. As shown in **Table 5**, the values of Skewness and Kurtosis for each variable indicate that, the constructs fell within the acceptable range.

**Table 6 Model summary**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .980ᵃ | .960 | .894 | .17162 |

The results of the multiple regression analysis, as shown in **Table 6**, R determines the correlation between personal trait and academic performance. These explain that the correlation between the two variables is 0.98 which signifies a strong positive relationship. Besides the result reveal a coefficient of determination, R2, which predicts the relationship between the independent variables and dependent variable, of 0.96. This means that 96.0 percent of the total variance in

the dependent variable (academic performance) is accounted for by the independent variables (extraversion, neuroticism .openness to experience, agreeableness and conscientiousness). This result affirms that personal trait is significant in creating academic performance.

**Table 7 ANOVAᵇ**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 2.134 | 5 | .427 | 14.490 | .000ᵃ |
| | Residual | .088 | 3 | .029 | | |
| | Total | 2.222 | 8 | | | |

a. Predictors: (Constant), ES, NM, OE, CN,AG

b. Dependent Variable: AP

(Source field work, 2015)

The results of the F-ratio, as shown in **Table 7**, indicates that the regression model is significant at $p < 0.001$. It can be concluded, that the regression model predicts academic performance strongly. In other words, the personal traits construct: Extraversion, Neuroticism .Openness to experience, Agreeableness and Conscientiousness (the independent variables) have the ability to predict academic performance (the dependent variable).

**Table 8.** Results of multiple regression analysis

**Coefficientsᵃ**

Coefficientsa

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 5.798 | .526 | | 11.022 | .000 |
| | ES | -.101 | .062 | 0.12 | -1.639 | .600 |
| | NM | .156 | .067 | 0.11 | 2.309 | .700 |
| | OE | -.887 | .130 | 0.46 | -6.844 | .000 |
| | AG | .048 | .093 | .048 | .514 | .000 |
| | CN | -.524 | .144 | 0.49 | -3.631 | .000 |

(Source field work, 2015)

The regression analysis presented in **Table 8** reveals that the creation of academic performance is determined by the personality traits construct of construct: extraversion, neuroticism .openness to experience, agreeableness and conscientiousness. Extraversion has a beta value of 0.12. This means that Extraversion explains 12 % of the aid academic performance, at a p-value of.060.This explains a negative significant association Extraversion with academic performance.

Neuroticism has a beta value of 0.11. This means that neuroticism explains 11. % of the aid to academic performance, at a p-value of.070. Regression model is significant at p < 0.001.This indicates a negative significant association of Neuroticism with academic performance. Openness to experience has a beta value of 0.46. This means that Openness to

experience explains 46. % of the creation of academic performance, at a p-value of.000. Regression model is significant at p < 0.001This shows a positive significant association of academic performance with Openness to experience

Agreeableness has a beta value of 0.49. This means that agreeableness explains 49. % of the creation of academic performance, at a p-value of.000.This indicates a significant association of agreeableness with academic performance. Regression model is significant at p < 0.001. This shows negative significant association of academic performance with Agreeableness. Conscientiousness has a beta value of 0.48 this means that Conscientiousness explains 48. % of

the creation of academic performance, at a p-value of.000.

This indicates a significant association of Conscientiousness with academic performance. Regression model is significant at p < 0.001. This shows positive significant association of academic performance with Conscientiousness. Therefore, only three hypothesized relationships between personality traits and academic performance were accepted. **Table 9** summarizes the research hypotheses and their results.

**Table 9.** Summary of research hypotheses and results

| Hypothesis | Description | Beta | t-value | Comments |
|---|---|---|---|---|
| H1 | is there a relationship between extraversion and academic performance | 0.12 | -2.42 | REJECTED |
| H2 | is there association between Neuroticism and academic performance | 0.11 | -1.23 | REJECTED |
| H3 | Is there a relationship between | 0.46 | 5.54 | ACCEPTED |

| | | | | |
|---|---|---|---|---|
| | openness and academic performance? | | | |
| **H4** | is there a relationship between Agreeableness and academic performance | 0.49 | 4.08 | **ACCEPTED** |
| **H5** | is there a relationship between conscientiousness and academic performance | 0.48 | 4.05 | **ACCEPTED** |

(Source field work, 2015)

## 4.0 DISCUSSION

The first finding showed that the students that, are highly conscientious performed better .This is due to the fact that conscientiousness is related to hard work, this would translate into academic performance. They are discipline in what they do and deliberately plan for their success. The studies result is supported by (Barrick Mount & Judge, 2001; Erdheim, Wang & Zickar 2006) that conscientiousness is one of the most consistent personality predictors of academic performance and found to show a positive relationship between conscientiousness and academic performance.

Finding also revealed that students who are agreeable performed significant better than their counterparts who are not. This is due to the fact that, academic involves socialization. These qualities make it easy to work together with colleague students and learn from each other. Being generous, friendly and helpful in nature makes it easy for them to received help and favour from fellow students as well.

The study shows that students who are high on neuroticism performed significantly worse than other trait. They are nervous, moody and emotionally over-reactive to minor issues. This agrees with the findings of Fadare (2010) who further opined that this category of people construe ordinary situations as threatening and frustrations as hopelessly difficult.

The study further shows that students who are openness performed significantly in academics. This is in congruent with Vermetten, et al. (2001) who established the fact that openness motivates critical thinking and disassociated with absenteeism.( Tempelaar, Gijselaers, van der Loeff, & Nijhuis, 2007) (Bidjerano & Dai, 2007, Lounsbury, Steel, Loveland, & Gibson, 2004).

## 5.0 CONCLUSION

In view of literature reviewed and data collected, analyzed and the findings derived. The following conclusions were made: There was a significant positive relationship between the academic achievements of tertiary student's who are conscientious, agreeable and openness however extroversion and neuroticism failed to pass the hypothesis test. The present study supports prior research that conscientiousness agreeable and openness are a critical factor

with regard to academic performance. Therefore, it seems that mediated relationships between conscientiousness, agreeable and openness and academic performance are ripe for future study.

## REFERENCES

Ackerman, P. L., & Heggestad, E. D. (1997).Intelligence, personality, and interests:Evidence for overlapping traits. *Psychological Bulletin, 121*, 219-245.

Barrick, M. R., Mount, M. K., & Judge, T. A. (2001). Personality and performanceat the beginning of the new millennium: What do we know and where do we go next? *International Journal of Selection and Assessment, 9*, 9-30.

Bidjerano, T., & Dai, D. Y. (2007).The relationship between the big-five model of Personality and self-regulated learning strategies. Learning and Individual Differences, 17(1), 69-81.

Costa, P T, & McCrae, R R (1992). Revised NEO Personality Inventory & NEO Five Factor Inventory: Professional Manual. Florida: Psychological Assessment Resources, Inc.

Chamorro-Premuzic, T., & Furnham, A. (2008). Personality, intelligence, and approaches to learning as predictors of academic performance. *Personalit and Individual Differences, 44,* 1596-1603.

Chamorro-Premuzic, T., & Furnham, A. (2006). Intellectual competence and the intelligent personality: A third way in differential psychology. *Review of General Psychology, 10,* 251-267.

Connor, M. C., & Paunonen, S. V. (2007). Big five personality predictors of post-secondary academic performance. *Personality and Individual Differences, 43,*971-990.

Day, D. and Silverman, S. (1989). Personality and Job performance: Evidence of Incremental Validity: Personnel Psychology, 42(1), 25-36.

De Raad, B., & Schouwenburg, H. C. (1996). Personality in learning and education: A review. European Journal of Personality, 10, 303-336.

Duff, A., Boyle, E., Dunleavy, K., Ferguson, J. The relationship between personality, approachto learning and academic performance. Personality and Individual Differences, 2004, 36, 1907–1920.

Elliot, A. J., & Thrash, T. M. (2002). Approach-avoidance motivation inpersonality: Approach and avoidance temperaments and goals.Journalof Personality and Social Psychology, 82,804–818

Entwistle, N. J., Tait, H., & McCune, V. (2000). Patterns of response to an approaches to studying inventory across contrasting groups and contexts. *European Journal of Psychology of Education, 15,* 33-48.

Eysenck, H. J. (1992). Personality and education: The influence of Extraversion, Neuroticism and Psychoticism. German Journal of Educational Psychology, 6, 133-144.

Fairweather, J. (2012). Personality, nations, and innovation: Relationships between

personality traits and national innovation scores. Cross-Cultural Research: The Journal of Comparative Social Science, 46, 3–30

Furnham, A., & Chamorro-Premuzic, T. (2004). Personality and intelligence as predictors of statistics examination grades. *Personality and Individual Differences, 37,* 943-955.

Furnham, A., Chamorro-Premuzic, T., & McDougall, F. (2003). Personality, cognitiveability, and beliefs about intelligence as predictors of academic performance.*Learning and Individual Differences, 14*, 49-66.

Furnham, A., Monsen, J., Ahmetoglu, G. (2009)Typical intellectual engagement, Big Five personalitytraits, approaches to learning and cognitive ability predictors of academic performance. BritishJournal of Educational Psychology, 79(4), 769-782.

Furnham, A., Moutafi, J., Chamorro-Premuzic, T. (2005) Personality and Intelligence: Gender, the BigFive, Self-Estimated and Psychometric Intelligence. International Journal of Selection &Assessment, 13(1), 11-24.

Hakimi S., Hejazi E., Lavasani M. G. The Relationships between Personality Traits and Students' Academic Achievement. Procedia -Social and Behavioral Sciences, Volume 29, 2011, Pages 836-845

Hijazi, Syed Tahir and Naqvi, S.M.M. Raza. (January 2006). 'Factors Affecting Students' Performance: A Case of Private Colleges'. Bangladesh e-Journal of Sociology: Volume 3, Number 1.

Hurtz, G. M., & Donovan, J. J. (2000). Personality and job performance: The Big Five revisited. *Journal of Applied Psychology, 85,* 869–879.

Kumar.N (2014) Effect of Nss on personality Traits of Students, International schorlar journal VOL. II/X, JAN-FEB, (1032-1037)

McCrae, R. R., & Costa, P. T., Jr. (1997). Personality trait structure as a humanuniversal. *American Psychologist, 52*, 509-516.

Noftle, Erik E.; Robins, Richard W. (2007) Personality predictors of academic outcomes: Big five correlates of GPA and SAT scores. Journal of Personality and Social Psychology, Vol 93(1), Jul 116-130

Ozer and Benet-Martinez (2006) Personality and The prediction of consequential outcomes AR REVIEWS IN ADVANCE10.1146/annurev.psych.57.1 02904.190127

Poropat, A.E. (2009) A Meta-Analysis of the Five-Factor Model of Personality and Academic Performance. Psychological Bulletin, , 135(2), 322-338.Lounsbury, J. W., Steel, R. P., Loveland, J. M., & Gibson, L. W. (2004). An investigation of personality traits in relation to adolescent school absenteeism. Journal of Youth and Adolescence, 33(5), 457-466.

Rosander P., Bäckström M., Stenberg G (2011). Personality traits and general intelligence as predictorsof academic performance: A structural equation modelling approach. Learning and

IndividualDifferences, Volume 21, Issue 5, Pages 590-596.

Trapmann, S., Hell, B., Hirn, J. O. W., Schuler, H (2007). Meta-analysis of the relationship between theBig Five and academic success at university. Zeitschrift Fur Psychologie, 215, 132–151.

Tempelaar, D. T., Gijselaers, W. H., van der Loeff, S. S., & Nijhuis, J. F. H. (2007). A structural equation model analyzing the relationship of student achievement motivations and personality factors in a range of academic subject-matter areas. Contemporary Educational Psychology, 32(1), 105-131.

Uziel, L. (2006). The extraverted and the neurotic glasses are of different colors. Personality and Individual Dierences, 41(4), 745-754.

Vermetten, Y. J., Lodewijks, H. G., & Vermunt, J. D. (2001). The role of personality traits and goal orientations in strategy use. Contemporary Educational Psychology, 26, 149-170.

**The Effectiveness of the Internal Audit Units in Ghana Education Service in Promoting Good Corporate Governance**

**John Mbah Aduku[1], Joseph C.A Azennaba[2]**
[1]Afrique Research Bureau, Monitoring and Evaluation Department

²Ghana Audit Service
Email: adukujohn@gmail.com / azennaba@gmail.com

**Abstract**

The need for financial accountability has existed ever since it became necessary for one individual to entrust the care of his or her possessions or business to another. Corporate governance, as an antidote to corruption, has received significant public and regulators attention in today's global world and the internal audit has been identified as the most effective control mechanism to ensure good corporate governance in the public sector. This paper, therefore, investigated into the effectiveness of the internal audit units in the public sector in promoting good corporate governance. Descriptive research method was employed. The sample size consists of 10 internal auditors, 10 Accountants and 10 Districts and Municipal Directors of Education within the Greater Accra region of Ghana. In selecting the respondents, both purposive and quota sampling techniques were used to select from the different categories of personnel. The paper revealed that the internal auditors receive less management support and the audit committees in the Municipal/District Directors directorates are not effective. It is also evident that majority of the internal auditors did not have requisite skills and experience. The units also experienced inadequate resources allocation. The paper suggests that the internal audit units in GES are not effective. Therefore, to ensure good corporate governance, the internal audit units should have appropriate governance structure, sufficient and appropriate resources and competent personnel. The results of this paper will help the GES as well as other institutions to put in place measures for their day to day management of safeguarding assets, prevention and detection of frauds, errors and irregularities.

**Keywords:** accountability; effective controls; irregularities; errors and corporate governance

## 1.0 INTRODUCTION

Internal audit is a cornerstone of good GES governance and it is essential for ensuring the operation and appropriateness of controls. It reviews compliance with existing financial regulations, instructions and procedures; evaluates the effectiveness of selected internal controls; appraises the efficiency and effectiveness with which resources are used; reviews reliability and integrity of records keeping and reporting, investigates irregularities; ensures that revenue is collected and accounted for and verifies inventory records and their relationship with physical inventory ( INTOSAI, 2011).

Internal audit is effective if it meets the intended outcome it is supposed to bring about. The internal auditor's work is not done until defects are corrected and remained corrected (Sawyer, 1995). Van Gansberghe (2010) explains that internal audit effectiveness in the GES should be evaluated by the extent to which it contributes to the demonstration of effective and efficient service delivery, as this drives the demand for improved internal audit service. According to Zeleke (2007) the internal audit activities help to prevent corruption, misappropriation of funds and other financial irregularities and ensure effective and efficient utilisation of resources to achieve the objectives of the organisation.

Iain & Stuart (2000) described this as ―agency theory‖. Agency theory is part of the positivist group of theories which is derived from the financial economics literature (Adams, 1994). It postulates that a firm consists of a nexus of contract between the owners of resources (the principals) and managers (the agents) who are charged with using and controlling those resources. It is also based on the premises that agents have more information than principals and that they will use the contracting process to maximise their wealth (Adams, 1994).

The Institute of Internal Auditors (IIA, 1999a) defined internal audit as: ―an independent, objective assurance and consulting activity designed to add value and improve an organisation‗s operations. It helps an organisation to accomplish its objectives by bringing a systematic disciplined approach to evaluate and improve the effectiveness of risk management, control and governance processes‖. This definition signifies that internal audit has undergone a paradigm shift from emphasis on accountability about the past to improving future outcomes to help Auditees operate more effectively and efficiently (Nagy & Cenker, 2002; Stern, 1994; Godwin, 2004).

However, the 2008-2009 global economic crises (Credit crunch) has undermined the very roles and purposes of the internal audit and above all, reduced the integrity of the internal audit units in promoting good corporate governance. Misappropriation of funds and corruption are now the order of the day in the GES in all countries due to weak internal control systems (Van Gansberghe, 2010). Centre for Democracy and Development (CDD) of Ghana (2010), reported that government officials misappropriate public funds especially at the local government level and this has resulted to huge government budget deficit, low standard of living, and poor economic performance. The question that everybody will ask is, are the internal audit units effective in this present situation since they are the key element of the internal control systems of every organisation? This has motivated the researcher to investigate into the effectiveness of the internal audit units in the Ghana Education Service (GES) in promoting good corporate governance.

As stated earlier, the focus of this study is to investigate into the effectiveness of internal audit units in the GES in promoting good corporate governance. It specifically sought to:

1. Find out the elements of good corporate governance.

2. Find out the activities that the internal auditors perform in the GES.

3. Bring into light the factors that contribute to the effectiveness of internal audit units in the GES.

4. Find out the advisory roles of the internal auditors in the GES

**2.0 METHODOLOGY**

This study was structured within the framework of descriptive research approach. Descriptive research studies are designed to obtain information, which concerns the current status of phenomenon.

The population of the study comprised some the internal auditors, Accountants and Municipal/District Directors of Education in the Greater Accra region. The Accountants were chosen because they deal with the financial affairs of the Education Directorates.

The Municipal/District Directors of GES who review the work of internal auditors as part of their role as spending officers will be in a good position to provide information on the effectiveness of the internal audit units. The total number of the targeted population will be estimated at 68 (which constitute 38 internal auditors, 20 Accountants and 10 Municipal/District Directors of Education).

The researcher employed simple random sampling to select internal auditors and used purposive sampling method for the Municipal/District Directors of Education. The Accountants from the respective Education Directorates of the internal auditors who were selected were given questionnaires. The selected Education Directorates included; Ga East Municipal, La-Nkwantanang Municipal, Adentan Municipal Education, Ada West, Ada East, Prapram, Ashaiman and Kpong Katamanso Districts. With respect to the Municipal/District Directors of Education, the researcher selected 10 Municipal/District Education Directorates within the Greater Accra region.

The questionnaires were pre-tested in the Ga-East, La-Nkwantanang and Adentan Education Directorates. Sheets were added to the questionnaires for the respondents to provide their comments and suggestions regarding clarity, weaknesses, ambiguities and problems of the instruments. The researcher obtained introduction letters from the Regional Director of Education as a way of formal introduction of the researchers to the respondents and this made it possible for the researchers to collect data from the selected Education Directorates.

## 3.0 FINDINGS

This section is devoted to the presentation of data and analysis of the responses made by participants under study.

**Elements of good corporate governance**

The researcher wanted to know why corporate governance is important in the GES. The respondents expressed that corporate governance is necessary to enable the GES to achieve their objectives of becoming a highly professional socio-economic services providers to their people. Others also stated that corporate governance would ensure effective and efficient utilisation of resources. Effective corporate governance reduces the incidence of corruption and builds confidence citizens have in public officials.

The respondents were also asked what elements ensure good corporate governance in the GES. The questions on the elements of good corporate governance were closed type and the respondents were required to respond to these questions using 5-point rated likert scale. The scale indicates the level of importance of each element, from very important (5) to very Unimportant (1). To answer this question, responses to item 7 of both internal auditors and Municipal/District directorate heads of Ghana Education Service were used. Their responses are summarised in figure 1 below.

**Table1:** Elements of Good Corporate Governance

| S/N | Statement | Frequency | Percentage |
|-----|-----------|-----------|------------|
| 1 | Transparency | 25 | 92.1 |
| 2 | Responsible | 3 | 7.9 |
| 3 | Equitable | 26 | 94.7 |

| | | | |
|---|---|---|---|
| 4 | Accountable | 2 | 5.3 |
| 5 | Effective | 10 | 78.9 |

Statistical evidence from Table 1 reveals that all the 38 respondents representing 100% indicated transparency at all levels of government, accountable to people and effective and efficient use of resources are very important in ensuring good corporate governance system in the GES.

Also, 25 of them representing 92.1% stated that responsible to people is very important in ensuring good corporate governance and the remainder (3) representing 7.9 % expressed it as important element of corporate governance. With regard to efficient and effective use of resources, 26 of the respondents representing 94.7% expressed it as very important while 2(5.3%) of them indicated it as important. Most (10) of the respondents representing 78.9 expressed that making information accessible to the citizens would also enhance corporate governance practice in the GES.

**Internal control activities**

Internal control systems are fundamental to the success and survival of organisations and it forms integral part of corporate governance system in the GES. The contribution of internal auditors in promoting good corporate governance is based on the scope of their work.

In the light of this, internal auditors were presented with 5-point rated likert type of scale items to provide their responses regarding the activities they perform in the GES. The research question two was answered using the item 16

of the questionnaire for internal auditors. The responses are indicated in table 6 below.

**Factors that hinder the effectiveness of the internal audit**

The success of the internal audit unit in delivering good corporate governance, as stated in the literature review, depends on the organizational settings, existence of approved internal audit charter, adequate resources, and existence of audit committee, management support and internal audit quality. To assess the effectiveness of the internal audit in the GES in promoting good governance, critical factors of internal audit function in each of the above areas were identified and the researcher solicited the views of the internal auditors and the heads of Ghana Audit Service in respect of these areas in order to answer research question three (3).

**Management support**

As per the professional standards of Institute of Internal Auditors, management support is one of the key areas that will ensure effective delivery of internal audit service in the GES. Figure 2 presents the results of management support to internal auditors in the GES.

**Table 2:** Management Support

| S/N | Statement | Frequency | Percentage |
|---|---|---|---|
| 1 | Implementation of internal audit | 23 | 83.9 |
| 2 | Commitment of | 4 | 14.3 |
| 3 | Management | 18 | 61.2 |
| 4 | Relationship with Management | 2 | 6.9 |

From the responses in Table 2, it is found that management support to the internal audit units is not good enough as 23 (83.9%) of the respondents expressed unsatisfactory about the implementation of internal audit recommendations by management, none expressed very satisfactory and satisfactory about it and 4 representing 14.3% were neutral on the issue. On commitment of management in supporting budgetary status of the internal audit units, 18 representing 61.2% of the respondents stated unsatisfactory, and 2 representing 6.9% expressed very unsatisfactory.

### Internal audit quality

To assess the internal audit quality, questionnaire and an interview were used to obtain evidence. Other documents such as audit plan, audit report and engagement letter were also reviewed to support the evidence.

### Expertise, strength and experience of internal audit staff

Evidence from the study showed that each GES directorate has an average of two (2) internal audit staff and 70% of the respondents expressed that the number is adequate while 30% of them stated the number is inadequate. Most (18) representing 60%of the respondents have Diploma, 9 representing 30% of them have degree and 2 representing 10% have other qualifications. However, none of them is a qualified accountant. With regard to experience, 95% of the internal auditors have only one year working experience. The heads of Ghana Audit Service in the region rated the experience and expertise of the internal auditors as below average and average respectively. Short-term courses and in-service training are necessary to upgrade the competences of the internal auditors. However, the GES are not doing much in this regard. The professional qualities that the internal auditors should posses include competencies, objectivity, and professionalism, independent attitude of mind, good judgement, integrity and confidentiality.

### Scope of service

The questionnaire responses and a review of audit reports reveal that the internal auditors concentrated on compliance of law and regulations; assessing reliability and soundness of financial information; evaluating of accounting errors and fraud detection. However, the internal auditors pay less attention to risk management, evaluation of project and productivity. This could be due to lack of experience and expertise to cover these areas.

### Determinants of effective internal audit

The researcher wanted to find out from the internal auditors and the Municipal/District directorate heads of Ghana Audit Service to what extent do they agree or disagree with the following factors that enhance the work of internal auditors. The factors were presented in a five-point likert-type of scale and the respondents were required to provide their responses using strongly agree (5) to Undecided (1). The findings are summarised in table 3 below.

**Table 3:** Determinants of the effectiveness of internal audit

| S/N | Statement | Mean | Standard deviation |
|---|---|---|---|
| 1 | Existence of audit committee makes internal audit effective | 4.74 | 2.11 |
| 2 | Competencies and experience of internal auditors makes internal audit effective | 4.56 | 2.03 |
| 3 | Approved internal audit standards, Act or charter makes internal audit effective | 4.76 | 1.78 |
| 4 | I'll put every effort to start and run my own business. | 4.23 | .412 |
| 5 | management support makes internal audit effective | 4.56 | 1.23 |
| 6 | Organisational independence makes internal audit effective | 4.78 | 1.56 |
| 7 | Implementations of recommendations makes internal audit effective | 4.68 | 1.62 |
| 8 | Adequate resources makes internal audit effective | 4.75 | 1.90 |
| 9 | Unrestricted access to records makes internal audit effective | 4.34 | 1.63 |
| 10 | Quality leadership of chief internal auditors makes internal | 4.67 | 2.01 |

**Scale**: mean of 4.6 to 5 is Strongly agreed, 4.0 to 4.5 is Agreed, 3.5 to 3.9 is Disagreed, 2.9 to 3.4 is Strongly disagreed and mean below 2.9 is Undecided.

From table 3, the respondents strongly agreed that the existence of audit committees (4.74) ,Competencies and experience of internal audit (5.000), Approved internal audit standards, Act or charter (4.56), Organisational independence (4.76), Management support (4.25), Implementation of audit recommendations (4.56), Adequate resources (4.78), Unrestricted access to records (4.68), Quality leadership of chief internal auditors (4.75) and Regular training of internal audit staffs (4.34) make the internal audit units effective.

**4.0 DISCUSSIONS**

The research revealed that, transparency at all levels of government, accountability to the public, equitable distributions of resources and inclusive policy, responsible to people and effective, efficient and economical use of resources are elements of good corporate governance. Also, the internal control activities of the internal audit unit in the GES focus mainly on the traditional paradigm of internal audit functions that focuses on compliance with laws and regulations, evaluating accounting errors and fraud rather than addressing risk management and productivity. Management do not give the internal auditors the necessary support.

The internal audit recommendations are not implemented and the units lack adequate resources. Management sometimes interfere with the work of internal auditors. In general,

the internal auditors do not have experience and they do not also have professional qualification in accounting and auditing field.

The structure and the organisational settings of the GES are restricting the roles of the internal auditors in delivering their services. They are partially allowed access to audit evidences and the GES do not have clear policies and procedures for internal auditors. Management perceived them as fault-finders and the units are given low status in the GES.

The factors identified as ensuring effective internal audit in the public sector are existence of audit committee, expertise and experience of internal auditor, management support, approved internal audit mandate and standards, unrestricted access to records, implementation of audit recommendations, adequate resources, organisational independence, regular training and quality of leadership of chief internal audit staff.

## 5.0 CONCLUSION

The evidence from the study indicates that the internal auditors are focusing their activities on compliance with laws and regulations, detections of errors and fraud, assessing unethical behaviour of management and evaluating management's efforts in recovering debts. From this evidence, it can be concluded that the scope of the internal audit activities is limited. Little attention is paid to risk management and project evaluation. Risk management is now the modern trend of internal audit and if internal audit unit does not pay much attention to it, corporate governance system will not be effective.

It was also clear from the findings that the internal auditors receive little support of management and the organisation settings are restricting their work. The internal auditors lack experience and expertise to provide quality work. There is no audit committee and internal audit charter in some GES to enhance the independence of the internal auditors. It can be concluded from these evidences that, the units are not effective in ensuring good corporate governance system in the GES.

On the basis of the findings, the following recommendations are proposed for the consideration of Internal Audit Agency, management of the GES and the internal auditors.

1. Every GES directorate should establish an audit committee. The audit committee should be made up of experts from different field that are independent from the management of the GES.

2. Each GES directorate should have its own internal audit charter. The management should involve the internal audit staffs and the audit committee in developing the charter.

3. The internal audit units need to be adequately resourced including the use of appropriate technology. The availability of resources would enable the internal auditors to do quality work within the timeframe.

4. There should be regular in-service training and short term courses for internal auditor. This would help them to upgrade themselves in order to meet challenges of modern internal audit.

5. The internal auditors should be given high status in the GES so that they cannot be manipulated by management. The chief internal auditors should be placed at a level that is recognised in the GES, preferable the level with the fiancé officers and other key influential persons in the GES.

6. The internal audit agency should monitor the internal audit units on regularly basis. Monitoring would help the agency to know whether the units achieving the desired results.

7. It is also recommended that the internal auditors should not stay in a particular GES directorate for more than two years. This is also necessary to enhance their independence.

8. The work of the internal audit units should not be decided by the Municipal/District Directors. The unit should be autonomous to decide what auditing activities to carry out. When Municipal/District Directors define the work of internal audit, the scope of the unit would be limited and the independence of the auditors would be at risk.

## REFERENCES

Adams, M. B. (1994).Agency theory and internal audit. *Managerial Auditing Journal,* 9(8), 8-12.

Bishop, W., Hermanson, D., Lapides, P., &

Rittenberg, L. (2010). ― The year of the audit committee‖. *Internal Auditor*, 46-51. Centre for Democracy and Development (CDD), Ghana (2010).

Iain &, J., & Stuart, T. Y. (2000). Two factors affecting internal audit independence and objectivity: Evidence from Singapore, *International Journal of Auditors*, 5(2),107-125.

INTOSAL (2012). *Internal organisation of supreme audit institution*. Available at *http.www.intosai.org* (accessed on 22/02/2009).

Sawyer, L. B. (1995). ―An internal; audit philosophy‖. *Internal Auditor*, 46-55.

Van Gansberghe, C. N. (2010). Internal auditing in the GES: A consultative forum in Nairobi, Kenya. Shores up best practices for Government audit professionals in developing nations. *Internal Auditor*, 62(4), 69-73.

Zeleke, W. G., (2010). *Business research methods* (2nd ed.).London: Harcourt College Publishers, 196.

**Factors Influencing Graduate Entrepreneurship Intentions in Ghana**.

**Eunice Antiaye**
Fashion, Designing & Textiles Department
Accra Polytechnic
dedeaddu@yahoo.co.uk

**Abstract**

Entrepreneurship is a major catalyst that drives the economy of most nations. Besides being the engine by which new ideas and novel approaches are introduced continually into businesses and the market

place, entrepreneurship guarantees economic returns from diverse forms of activities – including Research and Development (R&D). A major concern in many countries is the failure to see high levels of apparent intent to start up amongst graduates. This study investigates the relationship between social and closer valuation and intention to start a business by graduates in Ghana. Findings from the content analysis of 96 scripts provided the direction for the second phase, which was anchored on the Theory of Planned Behavior and the Social Capital Theory. Data was collected from a convenience sample of 179 level 300 and 400 students using the newly created Entrepreneurial Intentions Questionnaire (EIQ). Content analysis reveals that negative societal perceptions of entrepreneurship are important barriers against graduate start up, while regression analysis shows that the three antecedents of intention in the TPB are good predictors of intention. The relationship between close valuation and intention is fully mediated by subjective norm, attitude towards entrepreneurship and perceived behavioral control, while the relationship between social valuation and intention is not mediated by these antecedents of intention. Unlike studies in a Western context, this study establishes that family, peers, and colleagues exert a direct effect on intention .This finding underlines a particularity of entrepreneurship in collectivist societies.

**Keywords:** Unemployment; Entrepreneurship; Graduate Unemployment; Entrepreneurship Intentions; Innovation

## 1.0 INTRODUCTION

According to Gree and Thurnik (2003) entrepreneurship has been recognized as one of the tools that drives the economy of a country. Turker and Selcuk (2009) point out that entrepreneurial activities are not only the incubator of technological innovation, but they also provide employment opportunities and increase competitiveness. According to Maas and Herrington (2006) entrepreneurship is a significant component of the solution to Ghana's development issues. Entrepreneurship is fundamental to the growth of the Ghanaian economy and its future socio-political stability. Without the creation of new business Ghana risks economic stagnation. Herrington, Kew and Kew (2009) in the Global Entrepreneurship Monitor Ghanaian Report note that given the failure of the formal and public sector to absorb the growing number of job seekers in Ghana, increasing attention has focused on entrepreneurship and new firm creation and its potential for contributing to economic growth and job creation.

The government of Ghana has put the issue of graduate entrepreneurship high on its agenda. New policy and institutional frameworks have been introduced. For instance, the National Youth Employment Programme (NYEP) was launched in 2008 with the primary objective of improving entrepreneurship and reducing youth and graduate unemployment in Ghana. Despite all these measures graduate unemployment is still remain very high in Ghana. Studies on the entrepreneurial intention of graduates such as Frank, Korunka, Leuger and Mugler (2005) and Turker and Selcuk (2009) and Ismail,Khalid, Othman, Jusoff, Rahman, Kassim and Zain (2009) have focused mainly on developed countries. Barbosa and Moraes (2004) argue that studies carried out in developing countries are also

very important and may reach different conclusions from those carried out in developed countries. This is because there are environmental differences between developed and developing countries. For instance, unemployment rate is much higher in Ghana than in most developed countries and this may affect the entrepreneurial intention of university students. Therefore, it is critical to focus on graduates and understand which factors affect their intentions to start-up a business in the future. Furthermore it is important to identify the motivation and the actual or perceived barriers to the formation of new businesses in order to remove or lower entry barriers and improve business formation. The objectives of the study are to: Determine the entrepreneurial intention of Ghanaian graduates; determine the motivations and challenges to graduate entrepreneurial intention in Ghana.

## 1.2. Conceptual Issues: Entrepreneurship and Embeddedness

Drawing on the seminal work by Schumpeter (1934), entrepreneurship is widely viewed as a crucial mechanism for economic development offering employment, innovation and welfare by means of hard work, creativity and risk taking (Ashley-Cotleur, King and Solomon, 2009). For Kazela (2009) risk-taking behavior, driven by the expectation of making profit and the perception of good business opportunities, is one of the important attributes of entrepreneurs in overcoming the uncertainty of the market (Kazela and 2009).

In addition, Kazela (2009) shows that, for recognizing entrepreneurial opportunities, entrepreneurs require entrepreneurial skills. These skills encompass the competence and knowledge to act upon business opportunities, to be able to evaluate an opportunity and to turn it into enduring value (Kazela, 2009). While some authors maintain that these skills are innate behavior that some individuals possess "naturally" (Vesalainen, and Pihkala, 2000), others maintain that entrepreneurial skills can be obtained through education and training (Henderson and Robertson, 2000). The impact of education, in particular higher education, on entrepreneurial motivation and skills is of particular importance.

## 2.0 METHODOLOGY

The study focuses on graduating students at the University of Ghana, University of Professional Studies, Koforidua Polytechnic and Accra Polytechnic. The research was conducted in the four campuses of the four institutions. The target population of this research is the final year students both polytechnics and universities in Ghana. These are graduating students. Information obtained from the Registrations Department of the universities and polytechnics revealed that the population of graduating students is one thousand two hundred and forty four (1,244).

**Table 2.1** Sample Size

| Schools | Number |
| --- | --- |
| University of Ghana | 50 |
| University of Professional Studies | 50 |
| Koforidua Polytechnic | 50 |

| | |
|---|---|
| Accra Polytechnic | 50 |
| Total | 200 |

The researcher used the probability sampling method for the study. However, 200 questionnaires were distributed. With the approval and cooperation of lecturers, the questionnaires were distributed during class sessions for student with the regular session. For the evening session students, their telephone numbers and email addresses were obtained from the Registrations Department and the questionnaires were sent to their emails for completion. Repeated telephone calls to them ensured sizeable completion of the questionnaires. 179 questionnaires were returned indicating a response rate of 79.6%.

The questionnaire predominantly made use of Likert scale questions to determine entrepreneurial intention and the motivations and challenges to graduate entrepreneurship. Close-ended questions were used for demographic variables. The instrument was developed taken into consideration other similar studies such as Wong and Choo (2009), Benzing *et al.* (2009) and Phie (2009). Five point Likert scale with 1 meaning strongly disagree to 5 meaning strongly agree was used to measure entrepreneurial intention. The motivation variables were also measured using a five point Likert scale with 1 meaning unimportant and 5 extremely important.

The questionnaires were pre-tested using 20 graduating students at University of Professional Studies. The Cronbach's alpha was used as the measure of reliability. The data analysis was done using descriptive statistics, principal component analysis and T-test. This research study uses varimax orthogonal rotation method developed by Kaiser (1958). Principal components with Eigenvalues greater than one are usually retained. Items with factor loading lower than 0.300 were removed as suggested by Leech *et al.* (2005).

## 3.0. RESULTS AND DISCUSSIONS

200 questionnaires were distributed and 179 were returned indicating a response rate of 79.6%. 99 respondents were completing undergraduate degrees, 80 respondents were completing their diploma, and 128 respondents were males and 51 females. 97 respondents were aged below 25years and 82 above 25. 167 respondents have taken business courses and 12 respondents have never taken business courses

### 3.1 Entrepreneurial intention

**Table 1** Measures of entrepreneurial intention

| S/N | Statement | Mean | Standard deviation |
|---|---|---|---|
| 1 | My professional goal is to become an entrepreneur | 4.65 | 2.03 |

| S/N | Statement | Mean | Standard deviation |
|---|---|---|---|
| 2 | I prefer to be an entrepreneur rather than to be an employee in a company. | 4.55 | 2.00 |
| 3 | I am prepared to do anything to be an entrepreneur | 4.35 | 1.91 |
| 4 | I'll put every effort to start and run my own business. | 4.20 | .453 |
| 5 | I have thought seriously to start my own business after completing my study | 4.86 | 1.66 |
| 6 | I have a strong intention to start a business someday. | 4.80 | 1.94 |
| 7 | I'm determined to create a firm in the future | 4.86 | 1.66 |
| 8 | I want to be my own boss. | 4.80 | 1.94 |
| 9 | I will start my business in the next five years. | 4.77 | 1.67 |
| 10 | I will start my business in the next ten years. | 4.65 | 2.03 |

To measure the entrepreneurial intention of the graduates, a ten-item scale was developed after a review of the literature such as Choo and Wong (2009) and Pihie (2009). The scale mean for the ten measures of entrepreneurial intention is 1.65 on a five point Likert scale. The results indicate a low level of entrepreneurial intention amongst graduates in Ghana. The results suggest that most graduates prefer to work for private companies or public establishments. This is consistent with the findings of Kazela (2009) that the general perception among the disadvantaged communities is to earn an academic qualification in order to be more suitably qualified for the employment market. This is also one of the reasons for the low TEA rate in Ghana as pointed out by Herrington *et al.* (2009).

## 3.2 Motivations and challenges

**Table 2** Descriptive statistics for motivators

The control question that was used to measure entrepreneurial intention as related to motivations and challenges is "Are you seriously considering becoming an entrepreneur" A Yes answer is used to determine motivations and a No answer is used to determine challenges. 57 (17.7%) respondents answered Yes and 120 (82.3%) respondents answered No. If the answer is Yes, the respondents are then asked for the motivators. If the answer is No, the respondents are asked for the challenges.

### 3.2.1 Motivations

The variables with the highest means for motivators are to provide employment (4.82) and to provide job security (4.66). The variables with the lowest means are to maintain my family (1.97) and to enjoy myself (1.34).

| S/N | Statement | Mean | Standard deviation |
|---|---|---|---|

| 1 | To provide employment | 4.86 | 1.66 |
|---|---|---|---|
| 2 | To provide job security | 4.80 | 1.94 |
| 3 | Opportunities in the market | 4.77 | 1.67 |
| 4 | Earn a reasonable living | 4.65 | 2.03 |
| 5 | To take advantage of my creative talent | 4.55 | 2.00 |
| 6 | Support for potential entrepreneurs | 4.35 | 1.91 |
| 7 | For my own satisfaction and growth | 4.20 | .453 |
| 8 | I want to be my own boss. | 4.86 | 1.66 |
| 9 | To realise my dream five years. | 4.80 | 1.94 |
| 10 | For my personal freedom ten years. | 4.86 | 1.66 |
| 11 | To challenge myself | 4.80 | 1.94 |
| 12 | Good economic environment | 4.77 | 1.67 |
| 13 | I enjoy taking risk | 4.65 | 2.03 |
| 14 | To use the skill learned in the university | 4.55 | 2.00 |
| 15 | Entrepreneurial family culture | 4.35 | 1.91 |
| 16 | Increase my prestige and status | 4.20 | .453 |

The results indicate that most graduates who are interested in becoming entrepreneurs do so because of the fear of unemployment. According to Dhliwayo (2008) Graduate unemployment is particularly high in Ghana. There are too many graduates for few graduate jobs. Rwigema and Venter (2004) point out that one of the ways to solve graduate unemployment is graduate entrepreneurship. The rotated factor matrix for motivation is presented in Table 3

**Table 3** Rotated factor matrix for motivation

| S/N | Statement | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 1 | To provide employment | 0.91 | | | | |
| 2 | To provide job security | 0.84 | | | | |
| 3 | Opportunities in the market | 0.71 | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 4 | Earn a reasonable living | 0.82 | | | | |
| 5 | To take advantage of my creative talent | 0.74 | | | | |
| 6 | Support for potential entrepreneurs | 0.71 | | | | |
| 7 | For my own satisfaction and growth | 0.66 | | | | |
| 8 | I want to be my own boss. | | 0.87 | | | |
| 9 | To realise my dream five years. | | 0.65 | | | |
| 10 | For my personal freedom ten years. | | 0.61 | | | |
| 11 | To challenge myself | | | 0.79 | | |
| 12 | Goodeconomic environment | | | 0.77 | | |
| 13 | I enjoy taking risk | | | | 0.65 | |
| 14 | To use the skill learned in the university | | | | 0.59 | |
| 15 | Entrepreneurial family culture | | | | 0.54 | |
| 16 | Increase my prestige and status | | | | | |
| | Eigenvalue | 13.23 | 6.43 | 3.74 | 2.96 | 2.53 |
| | Percentage of variance explained | 38.06 | 19.62 | 8.50 | 6.74 | 5.34 |
| | Cronbach's alpha | 0.82 | 0.74 | 0.78 | 0.71 | 0.73 |

Five factors with Eigenvalues greater than one account for 78.3% of the percentage of the variance explained which were identified by the principal component analysis. Factor 1 is labelled employment which is an extrinsic factor. The factor has an Eigenvalue of 13.23% and a percentage of variance explained of 38.06%, suggesting that the factor is the most significant motivator. The factor consists of three items with factor loading greater than 0.3, which are to

provide employment, to provide job security and to earn a reasonable living. Factor two with an Eigenvalue of 6.43% and a percentage of variance of 19.62% is labelled autonomy and consists of four items.

The items include satisfaction and growth; own boss, personal freedom and realisation of dream. Factor three with an Eigen value of 3.74% and a percentage of variance explained of 8.50% is labelled creativity and it is an intrinsic factor. The factor consists of three items which are creative talent, challenge and risk. Factor four with an Eigenvalue of 2.96% and a percentage of variance explained of 6.74% is labelled the macro-economy and consists of two items which are good economic environment and opportunities in the market. The factor is an external environmental motivator.

Factor five with an Eigenvalue of 2.53% and a percentage of variance explained of 5.34% is labelled capital. This factor consists of both access to funds from personal savings and government and understanding of business skills learned in the university which can be termed human capital. Cronbach's alphas for the five factors are greater than 0.7, indicating the reliability of the factors. The findings are consistent with previous empirical studies such as Pihie (2009) and Choo and Wong (2009).

### 3.2.2 Challenges

The descriptive statistics and the rotated factor matrix for challenges are presented in Tables 4 and 5.

Lack of savings with a mean of 4.86 and difficulties in obtaining bank finance with a mean of 4.89 are the biggest challenges to graduate entrepreneurial intention. Five factors with Eigenvalues greater than one account for 84.8% of the percentage of variance explained were identified by the principal component analysis. Factor one with an Eigen value of 10.03% and a percentage of variance explained of 32.22% is labelled finance and consists of six items which are lack of savings, difficulties in obtaining bank loans, lack of collateral, crime, need to payback school loans and cost of business registration.

**Tables 4 and 5**

| S/N | Statement | Mean | Standard deviation |
|-----|-----------|------|--------------------|
| 1 | Lack of savings | 4.86 | 1.66 |
| 2 | Difficulty in obtaining bank finance | 4.80 | 1.94 |
| 3 | Lack of assets for collateral | 4.77 | 1.67 |
| 4 | Lack of business skills (financial, marketing) | 4.65 | 2.03 |
| 5 | Lack of information about how to start a business | 4.55 | 2.00 |
| 6 | Lack of business experience | 4.35 | 1.91 |
| 7 | Lack of information about any government agency that can assist in funding a business | 4.20 | .453 |
| 8 | Do not know how to write a business plan | 4.15 | .209 |
| 9 | Fear of crime | 4.02 | 1.48 |
| 10 | Need to pay school loans | 3.60 | 1.67 |
| 11 | Cost of business registration | 3.26 | 361 |
| 12 | Did not do any business management or entrepreneurial module | 2.75 | 1.56 |
| 13 | Cannot see any opportunity in the market place | 2.75 | .39 |
| 14 | The fear of starting a business because of a risk associated with a business | 2.68 | 1.49 |
| 15 | The uncertainty about the future if I start my own business | 2.62 | 1.91 |
| 16 | Fear of failure | 2.62 | 1.91 |
| 17 | Weak economic environment | 2.57 | |
| 18 | Lack of support from family or friend | 2.55 | 1.27 |
| 19 | Nobody in my family has ever gone into business | 2.15 | .890 |
| 20 | Convincing others that it is a good idea | 1.97 | .126 |
| 21 | No one to turn to for help | 1.90 | 1.32 |
| 22 | Finding right partners | 1.85 | .60 |

**Table 5**. Rotated factor matrix for challenges

| S/N | Challenges | Factor | Factor | Factor | Factor | Factor |
|-----|-----------|--------|--------|--------|--------|--------|
| 1 | Lack of savings | 0.91 | | | | |
| 2 | Difficulty in obtaining bank finance | 0.84 | | | | |
| 3 | Lack of assets for collateral | 0.71 | | | | |
| 4 | Lack of business skills (financial, marketing) | 0.83 | | | | |
| 5 | Lack of information about how to start a business | 0.74 | | | | |
| 6 | Lack of business experience | 0.71 | | | | |
| 7 | Lack of information about any government agency that | | 0.67 | | | |
| 8 | Do not know how to write a business plan | | 0.85 | | | |
| 9 | Fear of crime | | 0.76 | | | |
| 10 | Need to pay school loans | | 0.55 | | | |
| 11 | Cost of business registration | | 0.85 | | | |
| 12 | Did not do any business management or entrepreneurial module | | | 0.77 | | |
| 13 | Cannot see any opportunity in the market place | | | 0.59 | | |
| 14 | The fear of starting a business because of a risk associated with a business | | | | 0.81 | |
| 15 | The uncertainty about the future if I start my own business | | | | 0.72 | |
| 16 | Fear of failure | | | | 0.71 | |
| 17 | Weak economic environment | | | | | 0.84 |
| 18 | Lack of support from family or friend | | | | | 0.81 |
| | Eigenvalues | 13.23 | 6.43 | 3.74 | 2.96 | 2.53 |
| | Percentageof variance explained | 38.06 | 19.62 | 8.50 | 6.74 | 5.34 |
| | Cronbach's alphas | 0.82 | 0.74 | 0.78 | 0.71 | 0.73 |

The negative effects of crime such as costs of security, replacement and repair costs impact internally on the finances of the business. The factor has the highest Eigenvalue suggesting that it is the most important factor. Factor 2 with an Eigenvalue 6.44% and a percentage of variance explained of 24.01% is labelled competency and consists of five items. The

items are lack of skill, information, experience, business plan and entrepreneurial module. Factor 3 with an Eigenvalue of 4.14 and a percentage of variance explained of 14.92% is labelled support and consists of two items which are government support and family support. Factor four with an Eigenvalue of 3.29% and a percentage of variance explained of 7.12% is labelled risk and consists of three items which are risk, uncertainty and fear of failure. Factor five is labelled with an Eigenvalue of 3.01% and a percentage of variance explained of 6.55% is labeled macro-economy and consists of two items which are opportunities in the market and bad economic environment.

Cronbach's alphas for the six factors are greater than 0.7, indicating the reliability of the factors. Three of the challenges to entrepreneurship (capital, competency, risk) are internal to the graduate while the other two (support and economy) are external to the graduate. This suggests that challenges to graduate entrepreneurial intention are both internal and external. The findings are consistent with previous empirical studies such as Frank *et al*. (2005) and Benzing *et al*. (2007).

### 3.2.3 The importance of motivators and challenges

Table 6 depicts the scale means of the motivators and challenges.

**Table 6**. The importance of motivators and challenges

| S/N | Statement | Mean | Standard deviation |
|-----|-----------|------|--------------------|
| | **Motivators** | 4.86 | 1.66 |
| 1 | Employment | 4.80 | 1.94 |
| 2 | Autonomy | 4.77 | 1.67 |
| 3 | Creativity | 4.65 | 2.03 |
| 4 | Macro-economy | 4.55 | 2.00 |
| 5 | Capital | 4.35 | 1.91 |
| | **Challenges** | | |
| 1 | Capital | 4.15 | .209 |
| 2 | Skill | 4.02 | 1.48 |
| 3 | Support | 3.60 | 1.67 |
| 4 | Risk | 3.26 | .361 |
| 5 | Macro-economy | 2.75 | 1.56 |

Table 6 shows that the most important motivator of entrepreneurial intention for university graduates in Ghana is employment with a mean of 4.56 on a five point Likert scale. Lack of capital is the greatest challenges to entrepreneurial intention of Ghanaian graduates. The macro-economy is also significant challenges but has the lowest mean at 2.60. The T-test was used to investigate if there are significant differences in the mean scores of the demographic variables with respect to both the motivators and challenges. The results of the T-test show that there are no significant differences in the mean scores of the demographic variables with respect to the motivators and challenges.

### 4.0. CONCLUSION

The findings of this research show that entrepreneurial intention is very low in Ghana. In addition, the motivators of entrepreneurial intention include employment, autonomy, creativity, macro-economy and capital. The challenges to graduate entrepreneurial intention include lack of access to capital, lack

of competency, government support, risk and the macro-economy. To improve the entrepreneurial intention, the motivators must be reinforced and the challenges eliminated or reduced significantly. One of the ways to reduce the challenges to entrepreneurial intention is through entrepreneurship education. Entrepreneurial education is needed to enhance skills and knowledge. Entrepreneurial skills include creativity, innovation, risk-taking and ability to interpret successful entrepreneurial role models and identification of opportunities.

Entrepreneurial education thus provides basics of such practical business practices. Low levels of financial literacy can influence the degree to which entrepreneurs access formal sources of finance. These practices should broaden efforts to ensure that a high level of financial literacy is universal to prospective entrepreneurs. Entrepreneurship education should be made accessible to all tertiary learners in order to be equipped for business practices.

In addition, expert financial training greatly increases the chances of entrepreneurs securing appropriate and affordable finance. There is an evident skills mismatch between what skills graduate entrepreneurs developed in higher education and what they need in order to survive in the business world. It is recommended that university students should go for industrial attachments for at least a year during their study to gain valuable business and technical experience. Educational institutions should introduce and strengthen entrepreneurial education. When learners are oriented into entrepreneurship from an early age, it becomes easier to develop successful ventures.

There is the necessity for government support initiatives to be efficient. Government agencies such as GEDA, NYEP and other Development Corporations can organize practical trainings for students involved in entrepreneurship education or who would like to be involved in entrepreneurial practices.

This study is limited to the perception of potential graduates about the barriers to entrepreneurship. The real barriers encountered by graduates who actually started their own businesses were not investigated in the study. In addition, care should be taken to generalise the findings of this study to all Ghanaian graduates since the research covered only one university.

## References

Ashley-Cotleur, C, King, S., and Solomon, G.
  (2009). Parental and gender influences on entrepreneurial intentions, motivations and attitudes. [Online] Available: http://usasbe.org/knowledge/proceedings/proceedings Docs/USASBE 2003 proceedings-12pdf. (March 10, 2009).

Barbosa, E, G., and Moraes, C, C. (2004).
  Determinants of the firm's capital structure: The case of the very small enterprises. [Online] Available: http://econpa.wustl.edu.8089/eps/fin/papers 0302/0302001.pdf (August 18, 2007).

Benzing, C., Chu, H.M., and McGee, C. (2007).

Ghanaian and Kenyan enterprises: a comparative analysis of their motivations, success, characteristics and Problems. *Journal of Development Entrepreneurship*, 12(3):295-312.

Botha, M. (2006). *Measuring the effectiveness of women entrepreneurship program, as a training intervention on potential, start-up and established women entrepreneurs in Ghana.* University of Pretoria. D.Com Dissertation.

Choo, S., and Wong, M. (2009). Entrepreneurial intention: triggers and barriers to new venture creations in Singapore. *Singapore Management Review,* 28(2): 47-64

Demirguc-Kunt, B., Maksimovic, J. Beck, T., and Laeven, B. (2007). Young entrepreneurs of America. Available:http://yeabiz.wordpress.com/2007/05 /23/importance-of-entrepreneurship/ (June 1, 2009).

Development Policy Research Unit, University of Cape Town. (2006). Graduate unemployment in post-apartheid Ghana: nature and possible policy responses. [Online] Available: http://www.commerce.uct.ac.za/rese arch_units/dpru/PBriefsPDF/PDFs/ PolicyBrief07-14.pdf (March 10, 2009).

Frank, H., Korunka, C., Leuger, M., and Mugler, J. (2005). Entrepreneurial orientation and education in Austrian secondary schools. *Journal of Small Business and Enterprise Development,* 12(2): 259-273.

Gree, A., and Thurnik, C. (2003). Firm selection and industry evolution: the post country performance of new firm. *Journal of Evolutionary Economics,* 4 (4): 243-264.

Greene, F. J., and Saridakis, G. (2007). The enterprise concept. [Online] Available: http://www.ncge.com/files/biblio10 49.pdf (August 23, 2009).

Henderson, R., and Robertson, M. (2000). Who wants to be an entrepreneur? Young adult attitudes to entrepreneurship as a career. *Career Development International*, 5(.6) 279-287.

Herrington, M and Wood, T. (2007). Global Entrepreneurship Monitor: Ghanaian Report. [Online] Available*:* http://www.gemconsortium.org/file s.aspx?Ca_ID=126 (*July 27, 2009).

Herrington, M., Kew, J., and Kew, P. (2009).

Global Entrepreneurship Monitor, Ghanaian report.
Available:
http://www.gbs.nct.ac.za/gbswebb/ userfiles/gemsouthafrica2000pdf (October 15, 2009).

Ismail. M., Khalid. S. A., Othman. M., Jusoff. Hj. K., Rahman. N. A., Kassim. K. M., and Zain. R.S. (2009).

Entrepreneurial intention among Malaysian undergraduates. *International Journal of Business and Management*, 4 (10): 54-60.

Kazela, N. (2009). The roadmap of youth entrepreneurship. [Online] Available: http://209.85.229.132/search?q=cache :kXAoRIo2DhEJ:www.wcf2009.org/pr ogram/down/020_S7I043_Rock_Pow er_N_Kazela.doc+graduate+entrepren

eurship+risk+barrier+in+South+Afric aandcd=14andhl=enandct=clnkandgl =za (August 20, 2009).

Turker, D., and Selcuk, S, S. (2009). Which factors affect entrepreneurial intention of university students? *Journal of European Industrial Training,* 33(2): 142-159.

Vesalainen, J., and Pihkala, T. (2000). Entrepreneurial identity, intentions and the effect of the push-factor.

*International Journal of Entrepreneurship*, 3(2): 145-151.

**Museum and Art Education in Tertiary Intitutions of Ghana: The Takoradi Polytechnic Experience**

**Boakye-Yiadom Fredrick & Rex .I. Akinruntan**
Department of Sculpture, Takoradi Polytechnic
yiadomboa9@yahoo.com

**Abstract**

One of the cardinal aims of a museum is to educate the populace on fine arts, applied arts, craft, archaeology, anthropology and ethnology, history, cultural history, military history, science, technology, children's museum, natural history, and numismatics, biography , botanical and zoological gardens. Many scholars have been writing and are still writing on the need for academic institutions to have museums in the quest to address many issues based on the role museums play as a repository for the development of education. However, there is a direct relationship between museum and effective

art education at tertiary education level. The study examines the role and the socio- economic impact museum plays in Art Education in Takoradi Polytechnic Fifty six (56) structured questionnaires were administered to polytechnic stakeholders identified in this research. Whiles 'Boarexcom' adapted from Delphi panel was used for the fourteen (14) professionals and three (3) members from the management of Takoradi Polytechnic who are part of the academic cohort were added to the professional cohort. The findings revealed that, museum plays vital role in the development of Art education and offers a lot of socio-economic benefits. The research concludes by recommending the need to have a well-established museum for the development of art education.

**Keywords**: Museum, socio-economic, history, role, Art Education

## 1. INTRODUCTION

One of the cardinal aims of a museum is to educate. Many scholars have been writing and are still writing on the need for academic institutions to have museums in the quest to address many issues based on the role museums play as a repository for the development of art education. Museums collect and care for objects of scientific, artistic, or historical importance and not only make them available for public viewing through exhibits that may be permanent or temporary but also educational purposes especially in tertiary institutions (Bryson, 2003). Most large museums are located in major cities

throughout the world and more local ones exist in smaller cities, towns and educational institutions. In Ghana museums can mostly be found in Accra, and Kumasi. It appears the rest

of the regions lack the presence of museum let alone tertiary educational institutions. Museum brings a lot of benefits to tertiary educational institutions by enhancing their teaching, learning and research activities (Mack, J. 2003).

The research available to the researchers indicates that some works have been done in the area of museum and education. Ovenden, C. (2004). What are museums for? Bryson, J. B. Usherwood and D. Streatfield. 2002.) also wrote on the national museum past, present and future visions on education. However, no research work has been conducted on museum and art education in Takoradi Polytechnic which forms the scope of the work.

In 1948 UNESCO launched a new magazine – Museum. It was one of the first periodicals to be published by the young Organization and its very existence bore witness to the important role of museums in carrying out UNESCO's constitutional mandate 'to maintain, increase and diffuse knowledge by assuring the conservation and protection of the world's inheritance of books, works of art and monuments of history and science. Ghana is part of the UN charter and due to this Ghana came out with policy to demonstrate government's commitment to the National Cultural Policy (2004), to establish a Culture Trust Fund to give financial backing to the promotion of Ghana's diverse culture. The republic of Ireland has a cultural policy which indicates the establishment of museum in every art institution in the country for the preservation of every culture (Boruke, 2006).

Apparently, the situation in Takoradi Polytechnic is different and does not conform to the above statement. The polytechnic is an institution that trains students through hands-on programmes for the production of works with great value and must be kept in museums. The absence of a museum at Takoradi polytechnic does not encourage the conservation, preservation and restoration of art works. Therefore most of the students' and lecturers' works of art that must be preserved for educational and research purposes are at the mercy of the weather. This actually makes educational referencing very difficult, students are not encouraged to produce more, lecturers do not find it expedient to work to inspire students and finally unity amongst departments seem to be questionable, since there is no exhibition to engage new knowledge. If the records of the school's past and present cannot be adequately cared for, then the rationale of preservation 'by records' is challenged.

## 2. RESEARCH DESIGN

The study took in account, museum and art education. The populations for the study were lecturers, students, and managers of Takoradi Polytechnic, professionals working in and with museums, galleries, centre for national culture and some practicing artists in Sekondi\Takoradi. The research population was divided into two cohorts. They were the professional cohort comprising Directors, senior staff, and staff of museums, galleries, centre for national culture and some renowned artists. These respondents were selected from K.N.U.S.T museum, Otomfo,s museum,

military museum all in Kumase Kwame Nkrumah Mausoleum, Accra museum and Takoadi centre for national culture. The second one was the academic cohort. This also was made up of lecturers, students, administrators, and some workers of the school. All these were selected purposively because of their background and knowledge in the field of art. The total sample size was 70. 14 (20 percent) out of the total sample size was for the professional cohort and 56 (80 percent) represents the academic cohort. Takoradi Polytechnic management were 3(4.3percent), deans, 4(5.7percent), HODS, 10 (14.3percent), lecturers, 20 (28.6percent), students, 10 (14.3percent) and administrators 9, (12.9 percent). Initially, 80 people were recruited for the academic cohort with 56 formally agreeing to participate in the study, which lasted from the beginning of January to the end of April, 2015. 17 of the total population consisted of 14 individuals from the professional cohort and 3 management members from Takoradi Polytechnic comprising the rector, registrar and finance officer were put together and had a discussion.

The Delphi panel method which was used in this research was introduced as a means of future forecasting in the 1950s (Dalkey, 1969). It has since been refined to cater for wider range of fields and issues including education, health and science (Linstone and Turoff 1975, 2002).

Unlike other interview methods where responses are known only to the researcher, Delphi responses are shared amongst all participants. Delphi panel again allowed the usage of both quantitative and qualitative

dimension of approaches for the responses generated by the initial set of open- ended questions. Delphi panel is supposed to be an online discussion amongst respondents using computers with internet connectivity: Due to Ghana's inability to have internet connected computers all the time, however a conference call in a form of Delphi style was adopted to generate ideas and facilitate consensus amongst individuals who have knowledge and opinions to share but could not be physically met due to geographical disperse and this type of discussion was named 'Boarexcom'

The 'Boarexcom' enabled geographically dispersed and time pressured respondents to participate efficiently within the constraint of busy personal professional lives. For the first cohort 'Boarexcom' implemented four rounds of questions. All were open ended questions. The responses were collated and submitted for further comment.They were asked to respond to the research questions.

For the academic cohort, the research was carried out on the Takoradi Polytechnic campus. A total of fifty three (53) open ended questionnaires were distributed. The questionnaires administered to the respondents were retrieved completely with adequate supervision from the researchers. The data collected were analyzed using qualitative and quantitative methods. The respondents responded to the research questions. Below are they:

In considering the role of museum in art education, the researchers looked beyond the immediacy of the items in a museum to the long-term effects of museum on the school community. These effects may be related to social development such as education, entertainment and others, personal and economic development. In your opinion, what are the long-term roles of museum in art education on the individuals in the polytechnic community? Concrete examples should be given where museum affect social development, personal development and economic development. (Professional Cohort).

For the academic cohort, a similar question was asked: In your opinion, how will a museum contribute to your social development in this community? How will museum contribute to the development of a student in terms of an academic expediency? How will a museum contribute to the economic development of the polytechnic community? It should be understood that the methodology allowed for divergent responses. The rector openly declared, in answer to the question, "What does having museum in the school mean?"From the professional Cohort, it reinforces the formal educational system through extension programs, provide support for community education programs and build knowledge in the community by conducting formal educational programs such as art exhibitions, art seminars, and art lectures for the development of art education.

A respondent in the professional cohort agreed, that museum is important because: It tells us where we have come from. It illustrates the advancement of knowledge about the natural environment, technology, scientific and artistic historical discoveries. While another professional respondent asserted: Museum

continue to be hegemonic institution that reinforces the values of a powerful sector of society. (Academic) In your estimations, to what extent does the absence of museum affect art education? The absence reduces output of work where lecturers and students are not encourage to practice since most of their already made works are at the mercy of the weather. (Registrar) The absence affects creativity. As the adage goes practice make man perfect. The more one practices the more the creative thinking is put to use in other to come out with new and innovative products.

It reduces inspiration development, such that there are no works for lecturers and students to pick inspiration from in other to advance their own designs to produce to meet market standards. Again, it reduces work values and ethics, lacks the sense of belonging and involvement, lacks the promotion, contact and cooperation across different disciplines, lacks an internally generated funds which can be used to purchase tools, equipment and materials for the of production of arts for sale, lacks exhibitions, seminars, workshops which can be done periodically to promote creativity, artistic and cultural perception of artists. It affects research into material culture and lacks the development of careers. (Finance officer) This all members in this bracket accepted.

Another question was put to the professional cohort which was, how will the creation of museum contribute to effective teaching and learning art? A respondent in this cohort agreed that the creation of museum can help in the structuring of curriculum, the production of T.L.M, brings unity amongst lectures,

administrators, other workers, advancement in research, inspiring artists and would be artists to work hard, promote the sense of belonging, cooperation and foster the generation of IGF. (Director).

A respondent in the academic cohort also questioned the potential for the presence of museum to effective social charge: Both professional and academic cohorts agreed that museums provide opportunities for education and learning. The public cohort commented at length on the distinguishing qualities of museum learning, including the visual dimension of objects and the opportunities for personal reflection and the extension of horizons.

From the academic Cohort the visual representation of facts makes museum more accessible and interesting to visit for many more people, creates a great "hands on" learning experience, provides information for all five senses, gives an environment that is quiet, not intrusive yet offering assistance when required and in museum, people can spend as much time as they want pondering over an item.

In the opinion of the academic Cohort; Museum is a graphic and physical way of educating people about their own history and heritage and other societies' history and heritage give schools and special interest groups a place where they can see new discoveries in the area art, rather than have to read about them, provide education without the formality of a classroom, makes available to the community the means to learn and see outside its own environment and provides a

place for people to be educated about the world of art. In short, from the professional Cohort museum provides a free choice environment to pursue individual interests and discovery learning.

According to both Cohorts, museum provides the opportunity to experience a sense of belonging around shared collective values, the "permanency" of museum endows them with significance as the guardian and repository of that part of the collective memory most valued by communities, enables us to understand the present and foreshadow the future by reflecting on evidence and experience from the past, provides a counterpoint to globalization by affirming regional and local community identity reflects, constructs, defines and explores national values and reinforces a sense of community identity, values and worth through art education. Someone from the academic Cohort added, that museum can make people feel that they belong to a common heritage, gives communities a sense of place, provides a place to learn more about the shared experiences that matter to all of us and contributes to a sense of local pride as they say "we have something which is unique and valued by others."

The development of an art museum can spark community spirit and awaken civic consciousness and co-operation and provides a focus for communities to celebrate significant cultural events and rituals to enrich the development of art education. Again, museum provides the focus for active commemoration and memorialization of significant local and national events and gives the focus for forging new community networks the promotion of art education. (Both cohorts).

Museum generates social interaction between out-of town visitors and people who live in the local community, and allows different people from different backgrounds to come together around common interests to discuss about the museum and its items which can benefit the development of art in the school. Museum contributes to the social development of a community if they have committees or "friends groups" who work together to facilitate the social development of the community by showing its progress, achievements and improvements over time to the outside world and they also offer contributions that will support the improvement of art education. (Both Cohorts). Has the National Museums in the country caused people to think of being patriotic to the country, research oriented and development driven individuals? Not exactly. (Director)

## 3. RESULTS AND DISCUSSIONS

The findings from this study indicate that professionals in the industry and the people from the Takoradi Polytechnic Community agreed that museums have significant roles to play in the development of art education (social and human capital, societal change, community building, public awareness and economic developments).

For Social capital the study indicated that Museum contributes to the communication of ideas. This is so because people meet at a museum and share ideas which contribute to the assessing of information and values of

which the understanding of different cultures are attained to support the development of art education.

In the area of building and developing communities it was revealed that museum contributes to developing sense of community identity, social cohesion, recreational opportunities, development and help to convey history and heritage of an area. This is so because the art works in the museum tell people the people's history, where they are coming from and the kind of things they do as citizens of the community.

People criticize the works the way they think freely and the artist or the curator has to accept the comments either good or bad in good faith. This kind of exercise brings understanding between the critics and the artist and improves the artist skills and knowledge.

It was found out that, something new is learnt always by visiting a museum, making it the perfect environment for learning, both for younger people to learn about culture and for older people, as part of life-long learning. Museum serves as school in a literal sense as well, for young people to complete work placements and for academics to conduct research. Visiting a museum means learning, whether it's consciously or unconsciously, intentionally or unintentionally.

The study showed that Museums make the population of the study which is the professionals and the academic cohorts think, and sometimes they inspire them to take certain critical decisions that will go to benefit the museum. It is as well an ideal environment for personal development and fulfillment.

However, museums are also enjoyable places to visit to relax, to enjoy beautiful objects and fascinating stories – even to experience happiness. Museum also provides freedom of movement and experience, both literally and figuratively of volunteers, museums' appeal to businesses and to families with high levels of education, and the cachet and character a museum and its building can give to the Institution, Takoradi Polytechnic. Museum is full of activity, life and appeal – places in the heart of the community that have economic significance as well. For instance the large numbers of tourists that museum attracts, the jobs they create directly and indirectly, the capital represented by the thousands From the results, more respondents were uncomfortable with the non-available of museum presence at the school which none-the-less should be provided.

In finding the tourist visit as it contributes to the economic development of a community, four indexes were found out and they include increased earnings, increase in foreign exchange earnings, international trade and exchange programmes.

The research results indicate that the absence of museum in the school has the following effects on art education; inadequate materials for effective referencing, inadequate ability for students to use their cognitive, affective and psychomotor skills properly. Furthermore, the absence of a museum does not inspire both teachers and learners to work hard.

Again, it does not foster unity amongst teachers, learners and non-teaching staff of the school. Lastly, the absence of museum

discourages the generation of internally generated funds for the development of the school.

The research has proven that the presence of museum in Takoradi Polytechnic community will contribute positively to art education in terms of materials for effective referencing, thereby resulting in the ability for students to use their cognitive, affective and psychomotor skills properly to come out with innovative designs to enhance art education.

85 percent of the respondents believe that Museum has extensive experience in managing and recruiting volunteers that is service persons from the art departments and students' attachment, thereby helping them to gain the skills and work experience whiles the long – term unemployment can use volunteer work to help them re-enter the job market.

It was found out that museums have friends who are members who may be private individuals, companies and non-governmental organizations. These friends' may generate funds and supply volunteers as well as being involved in promotion and variety of other activities for the community members to learn from each other.

All the two cohorts representing 100 percent accepted that Museum makes people think, and sometimes they inspire us to take action. Museum provides the tranquility and freedom to reflect and think critically, as well as being an ideal environment for personal development and fulfillment. However, museum is also an enjoyable place to visit to relax, to enjoy beautiful objects, fascinating stories, and even to experience happiness. It also provides freedom of movement and experience, both literally and figuratively.

All the academic cohort and two members from the professional cohort believe that, museum is full of activity, life and appeal-places in the heart of the community that have economic significance as well. Looking at the large numbers of tourists that museum attracts, the jobs it creates directly and indirectly, the capital represented by the thousands of volunteers, museum appeals to businesses and to families with high levels of education.Theacademic Cohort stated that, as museum is an important sources of history to help guide us into the future, its absence is an indication that there is no future for the school, therefore practical education is challenged.

## 4. CONCLUSION

As we approach the millennium, it is incumbent on every tertiary institution in Ghana of which Takoradi Polytechnic is a part to have at least a museum to show leadership in the promotion of art education. The presence of a museum in Takoradi Polytechnic will serve as a custodian of the cultural soul of the school, and it will have the capacity to broker peace, unity and understanding. It will tackle problems in the society, such as lack of appreciation by the citizens in their involvement in the preservation of the heritage and the cultural property of the school. As institution, there must be the preparedness to speak through exhibitions and programmes for the good of the school and the nation as a whole.

Museums have many roles, responsibilities and functions, some of which arose with the origin

of western museums hundreds of years ago, others very new. This is a major debate in the field of Museum Studies as well as other associated fields. Some historical roles have included the museum as a place for academic research, as an educational institution, or both. Takoradi Polytechnic museum if established will perform in this role. More recently museum has been championed as a place of social interaction, a center for social justice and even a space for experimentation, invention and innovation where visitors can learn how to get involved. What do you think? Should Takoradi Polytechnic have museum or not?

Considering the importance roles museum play as a veritable source of internally generated funds and its growing importance in reducing balance of payment deficit in an institution, it can act as a substitute to the Get Fund which is not forthcoming from the government end. Thus museum management as well as its development and marketing will play an important role towards providing an alternative source of income and stimulating departmental development at the school, and the country at large. As it was stated by the professionals, museum offers people the opportunity to learn informally, something they can do on a voluntary basis. They learn to view objects with their own eyes, find out more about it and actually use them, by feeling, tasting, smelling or playing. They find out they can learn more in a museum than in a classroom. Students and other People cite 'improving general knowledge' and the 'informal learning experience' as major reasons to visit a museum.

They describe this learning experience as gathering information and acquiring knowledge, and regard it as a useful way to spend their leisure time.

This learning experience fills a personal need and increases people self-esteem. For the people in the Takoradi Polytechnic community, informal learning, alongside regular education, is important in developing their worldview and self-image, along with their personalities, identities and social awareness. While museum and art education provide general knowledge in the role museum can play in academic development in Takoradi Polytechnic it is not a substitute for in-class instruction or the vital role the school must play in terms changing the academic calendar. Nor is it a way to cover all topics and situations a student may encounter. Instead, the idea is to represent one point along the way in the understanding of the need to own a museum in the school to bring social developments.

**References**

Bouke, M. (2006). *Why museum matter*: International council of museums Paris.

Bryson, J., B. Usherwood and D. Streatfield. 2002. *South West Museums, Archives and Libraries Social Impact Audit. University of Sheffield, Center for Public Libraries and Information in Society.* Sheffield, England: Department of Information Studies.

Bud, R., M. Cave, S. Haney, 1991. Measuring a museum's output.
Culture, Media and Sport. 2000. *Centers for Social Change: Museums, Galleries and Libraries for All: Policy Guidance on Social*

Inclusion for DCMS funded and local authority museums, galleries and archives in England.

Dalkey, N. C. 1969. *An Experimental    Study of Group Opinion: The Delphic Method. Futures 2*, no. 3 (September). Department of *in the South West*. Bristol: Bristol Cultural Development Partnership.

Kelly, A. and A. Kelly. 2000. *Impact and Values, Assessing the Arts and Creative Industries*

Linstone, H., M. Turoff. 1975. *The Delphi Method: Techniques and Applications.*

Mack, J. (2003). *The museum of the mind – Art and memory in the cultures*. London: British museum press. *Museums Journal* (January). National Commission on Culture 2004, Cultural Policy statement. Ghana

Ovenden, C. (2004). *What are museums for?* A Cumberland lodge conference. London. Reading, MA: Addison-Wesley.  2002. *The Delphi Method: Techniques and Applications*.

UNESCO 1948, museum International vol,50,No1,1998 UNESCO Paris Published by Blackwell publishers,108 Cowley Road, Oxford, ox4,1JF UK and 350 Main Street, Malden, MA02148(USA). Americans for the Arts (2009*) Arts & Economic prosperity. The economic impact of non-profit Arts and culture organizations and their audiences:* Americans for the Arts: Washington

# Digital Textile Printing: A New Alternative to Short-Run Textile Printing in Ghana

**Charles K. Ntim[1], Sophia P. Ocran[2] and Richard Acquaye[3]**
*[1]School of Applied Arts, Takoradi Polytechnic, Takoradi, Ghana.*
*[2]School of Applied Science and Arts, Cape Coast Polytechnic, Cape Coast, Ghana.*
*[3]Winchester School of Art, University of Southampton, Southampton, UK.*
*Email: chant2kk@yahoo.com*

## Abstract

This paper is a part of broader research into textile design technology and trends across the world and their reflection on the local Ghanaian textile industry. It places conventional manual screen printing and digital textile printing technologies side by side and discusses the various drawbacks of screen printing as against the advantages of digital textile printing. The study makes a case for a wider consideration of digital textile printing in Ghanaian small to medium scale textile production. Short-run textile printing commissions are the main source of jobs for small to medium scale textile producers in Ghana. Manual screen printing is the main process employed by these small-scale textile printers. However, screen printing has various layers of limitations and these limitations cast a very negative shadow on the overall outcome of the prints. This is because as it stands now short-run textile printing commissions are either produced manually, of course, with several inconsistencies or outsourced to China and other countries. This is because, the main textile factories in Ghana could print a minimum yardage in excess of 2400 yards due to their machines settings, calibration and running cost to make

the least returns. This presentation will highlight some of the milestone developments in digital textiles print machines and examine some of the key aspects of their tremendous production aptitudes for short-run textile commissions. The case study research method is used because data comes largely from documentation, archival records, interviews and physical artefacts.

**Keywords**: Textile Design; Digital Textile Printing; Screen Printing; Short-run Prints.

## 1. INTRODUCTION

This study is an exploratory exercise into the realm of Digital Textiles Printing that primarily seeks to make a case for the consideration of the technology to revolutionalise textile printing by small to medium scale textile printers in Ghana. This study seeks to give a background and trigger discourse in the area of digital textile printing and to raise awareness of its production potential. Digital textile printing is a generic term used to describe all methods of printing where a digitised image is transferred onto the substrate (Bowles and Isaacs, 2011). Broadly, there are two different types of digital printing technology namely: the electrostatic and continuous flow and drop on demand (dod). The dod technology has two subcategories: thermal and piezoelectric. Piezoelectric dod inkjet technology is currently the primary method for digital printing of textiles. As the most significant advance in fabric printing technology since the invention of the silk screen, digital textile printing is bringing about a revolution in textile design. Designers are seeking inspiration from previously unexplored sources, and a new visual language for surface design is starting to evolve. According to Anand and Horrock (2004), the latest advance in textile printing can be attributed to the introduction of digital inkjet printing machines, capable of printing fabrics up to 2m in width using acid, reactive or disperses dye ink set. The fabric is normally pretreated and placed in the machine in role form printed and then the dyes are fixed, usually by steaming in a separate machine, wash of and dried. Also, the piezoelectric and bubble jet printing systems may be used with any unused colour being diverted back to the ink reservoir and recycled. Generally four, seven-eight and up to twelve colours may be printed. Digital inkjet printing systems are designed principally for use with textile materials, including natural fibre-based substrates such as cotton, silk and wool fabrics as well as polyester-based fabrics, linoleum and Formica. These fabrics are specially prepared for digital printing (these fabrics are impregnated with chemicals and fixative).

On some machines, the inkjets are periodically cleaned with solvent, automatically, to avoid jet blockage. Particularly with disperse dye system such printing machines may be run overnight without operator supervision, the design images being pre-loaded, and design change over being essentially instantaneous. Other systems are already being used for printing flags and banners and clearly have great potential for printing short

production run of advanced technical textiles fabrics. Ultimately, some of reprographic printing method may be developed and research and development along these lines are continuing. Digital printing thrives on a chain of support systems. The computer is the main tool; however, the following are some other

important component that ensures effective and smooth process. Digital Printer, Scanner, Joystick, Standard digital printing inks (reactive, acid, etc.).

Screen printing is a printing technique that uses a woven mesh to support an ink-blocking stencil. It is done either with flat or cylindrical screens made of silk threads, nylon, polyester, vinyon or metal. The printing paste or dye is poured on the screen and forced through its unblocked areas onto the fabric. Screen printing is also a stencil method of printmaking in which a design is imposed on a screen of polyester or other fine mesh, with blank areas coated with an impermeable substance, and ink is forced through the mesh openings of the mesh by the fill blade or squeegee and onto the printing surface during the squeegee stroke (Mazharul, 2014). The amount of yardage that could be printed at one time was limited by the length of the printing table, the speed of the operators, and the number of colours to be used. The fabric is spread flat on a padded table and fastened securely to the table. The operator(s) lay the screens in place, one at a time and forced the dye through the openings in the screen with a squeegee. This is repeated as many times as there were screens and colours for the particular design. When the fabric was completed, it is moved to racks over the printing table to dry. The amount of dye forced through the screens is controlled by the amount of pressure the printer apply so the layer of colour can be very thin or somewhat thick.

**1.1 Evolution and Development of the two Printing Techniques**

According to Mara (1979) some of the earliest applications of screen printing can be found in Japan, but it appeared in Europe in the 18th century particularly in France for stencilling patterns onto fabric and objects like shoes. In the 19th century, it remained a simple process using fabrics like organdy stretched over wooden frames as a means to hold stencils and their 'islands' in place during stencilling or printing. Only in the twentieth century did the process become mechanised, usually for printing flat posters or packaging and fabrics. It became widely used to print coloured wallpaper as a cheaper alternative to printing with wooden blocks.

Not until the 1930's did the potential of screen printing come to the attention of artists, and even in the early 1950's it remained a crude and hand done process. Faine and Blake (1989) further indicated that, gradually though the industrial applications had grown and with them better machinery but more importantly much finer and thinner films oil based inks. In the 1960's many artists found its large scale and solid bright colours perfect for the ideas of the time particularly in Pop Art. To print multiple copies of the screen design on garments in an efficient manner, amateur and professional printers usually use a screen printing press. Many companies offer simple to sophisticated printing presses. Most of these presses are manual. A few that are industrial-grade-automatic printers still require some amount of manual labour to increase production significantly. Till date screen printing processes has remained essentially the same with very minimal sophistication. Often it is used as a

substitute for many other processes such as offset lithography. As a printing technique, it can print on almost any surface whether it is paper, card, wood, glass, plastic, leather or any fabric. In the publishing industry, it is used as a means of reproducing watercolour often in limited editions though these cannot be said to be true original prints.

Digital textile printing technology on the other hand, is a relatively new design output milestone. It started in the 1970s as a possible replacement for analogue screen printing. With the development of a dye-sublimation printer in the early 1990s, it became possible to print with low energy sublimation inks and high energy disperse direct inks directly onto textile media, as opposed to print dye-sublimation inks on a transfer paper and, in a separate process using a heat press, transfer it to the fabric. Behind digital printing is a range of software that is used in the design process and also in the preparation of the design for print. This only came within the remit of textiles designers once the technology for digital printing of textiles became viable in 1998. The off-the-shelf package Adobe Illustrator was first released in 1987 as a font development programme for graphic designers and later Adobe Photoshop followed in 1990. Although textile designers would have been able to use these tools, they were initially the domain of photographers and graphic designers. A true digital style for textiles emerged ten years later (Provost, 2015).

Seiren, a Japanese company, was also a pioneer of inkjet textile printing and begun testing the viability of this technology as long as early 1980s. By 1991, they had introduced inkjet printing in textiles alongside traditional methods. Most of their early prints ended up on the custom car interior market. Fish (2005) projected that, digital printing is only a small part of the printed textile market but this will change in the future, as it will become more cost effective than other printing methods. The limitation at that moment was that the printers were very slow and used only conventional inks. Table one gives a breakdown of major digital textile printing machine developments over the last 40 years.

**Table 1:** Major Digital Textile Printing Machine Developments over the last 40 years

| Year | Design Reference | Company |
|---|---|---|
| **Early 1970's** | Multi Coloured Ink Jet Printing Rig for Continuous Print Head | ICI/CCL(UK) |
| **Early 1980's** | Continuous Ink Jet for Textiles | Burlington (USA) |
| **Late 1980's** | 'Viscotec' Concept Developed | Seiren (Japan) |
| **1991** | First Commercial System Trucolor TCP – Hertz Continuous Technology, Reactive Dye Range | Stork (Holland) |

| Mid 1990's | Bubble Jet (Thermal dod) | Canon (Japan) |
|---|---|---|
| 1998 | First TX Series, Textile Printer using Epson piezo dod Technology | Mimaki (Japan) |
| 2003 | First Industrial Type Digital Printer (Aprion Piezo Magic Print Head) | Reggiani (Italy) / Scitex (Israel) / Ciba (Swiss) |
| Mid 2000's | Single Pass Industrial Printer (Image Print Head) | Osiris BV (Holland) – assets Purchased by Ten Cate in 2011 |
| 2011 | **MS LaRio High Production Digital Printer (KJ4B dod Piezo Heads)** | **MS Italy** |

## 2. METHODOLOGY

The qualitative method of research was employed. Qualitative methods consist of different orientations and approaches that make use of cognitive and cooperative knowledge construction that lead to data gathering and analysis strategies that generate appropriate findings (Vasilachis de Gialdino, 2011). Case study research, through reports of past studies, allows the exploration and understanding of complex issues. It can be considered a robust research method particularly when a holistic, in-depth investigation is required. Recognised as a tool in many social science studies, the role of case study method in research becomes more prominent when issues with regard to education (Gulsecen & Kubat, 2006), sociology (Grassel & Schirmer, 2006) and community-based problems (Johnson, 2006), such as employment and trade. This study is about small to medium scale textile production hence case study was used for the data collection. "One of the reasons for the recognition of case study as a research method is that researchers were becoming more concerned about the limitations of quantitative methods in providing holistic and in-depth explanations of the social and behavioural problems in question. Through case study methods, a researcher can go beyond the quantitative statistical results and understand the behavioural conditions through the actor's perspective. By including both quantitative and qualitative data, case study helps explain both the process and outcome of a phenomenon through complete observation, reconstruction and analysis of the cases under investigation" (Tellis, 1997).

A purposive sample of 82 participants were selected to effectively represent the population that consists of small scale textile producers in Greater Accra, Western, Ashanti, Central, Eastern and Volta region. The sample is made up of people who were very familiar with the rudiments of screen printing and other fabric printing methods. Interview and observation were used as the main data collection

instruments. Simple descriptive statements were used to explain and bring out the meanings and effects of the results of data collection. The interviews were conducted in order to gain in-depth details and information about participants' opinions and views regarding knowledge on screen and digital textile printing. The interviews were semi-structured; Sarantakos (2005), stated that semi-structured interviews stand somewhere between structured interviews and unstructured interviews, as they might share some elements of both types. There is usually an interview agenda or schedule with a plan or set of questions in a semi-structured interview; however, the agenda is mainly used as guidance for the interviewer instead of fully controlling the discussion (McQueen and Knussen, 1999). Semi-structured interviews are more flexible compared to other types of interview. They can provide more information because interviewees have the opportunity to be more elaborate in expressing their views and describing their experiences, which provide the researcher with information that may be of significant and extensive value.

## 3. RESULTS

As mentioned earlier in the methodology a less structured interviews was conducted to ascertain the level of knowledge of digital textile printing amongst small to medium scale textile printers in six regions of Ghana. It came out that 70% of the respondents know of digital printing (most of these respondents have had formal education in textiles and heard about it in school). 7% percent of the respondent have seen some of the printers when they travel

outside side the country to print commissions in China and also during their training outside the country. None of the respondents were using digital printer at the time of the interviews. However, 26 of the respondents have T-shirt printing machine rather that operated similar to the digital textile printer except the process is not continuous. When asked why they will not want to invest in a progressive technology such as digital textile printing, most of respondents cited initial cost, technical support, operational uncertainties and other maintenance constraints as the main deterrents.

## 4. DISCUSSION

### 4.1 Screen Printing Problems

As indicated earlier in this study, screen printing is the main process for producing short-run textile commission by small scale textile producers in Ghana. However, screen printing has several operational challenges and various layers of faults and drawbacks. This list is endless: Choking of screens, Misfitting of the design, Stains, Conveyor stain, Blanket stain, Misprint or no print on selvedge, Design not washed out properly, Slippage on the cloth, Pinholes, Pilling of the lacquer, Placement problems, Consistency of placement, Colour correctness, Colour consistency, Colour smear, Dye migration, Scorching, Improper curing, Fibrillation or frosting, Distortion, Opacity, Poor wash fastness, Registration, Hand, Colour out and Scrimps (Mazharul, 2014). Prior to these faults and challenges, there are other issues with the screen development too. Over-exposure causes a loss of detail in the image

area. When photo emulsion is exposed to Ultra Violet light, it polymerises or will crosslink, making it more difficult to wash out. As Ultra Violet light reaches the photo emulsion it becomes cross-linked, rendering it difficult or impossible to wash out during the development stage. This over-exposure happens in photo emulsion stencil making when the exposure is longer than it should be and the Ultra Violet light begins to creep around the edges of the positive areas of your art, thus decreasing fine lines or completely obliterating them.

A cocktail of these faults are always at play at any given time when doing screen printing. This adversely affects the consistency, uniformity and excellence of screen printed fabric outcomes. Attempts at remedying theses faults over the years have not been very successful so they are managed at a great expense.

**4.2 Digital Textile Printing Prospects**

Bowles and Isaacs (2011) related that, digital textile printing has some major advantages over traditional printing methods in design terms. These are: immediacy; the ability to print intricate details and millions of colours as well as the possibility of printing images on a much larger scale; being able to create customized products and engineered designs, An 'engineered' or 'placement prints, are tailored to fit the pattern pieces of a garment in such a way that, when assembled, there is a degree of continuity- the design flows unbroken around the body and image or repeated pattern is not broken by the seams. These garments are perceived as being more luxurious if a

placement print were employed, as such designs are more costly and time-consuming to produce. The fact that digital tools make it easier to create an engineered prints is a very exciting prospect for fashion and textile designers alike, as both digital print and digitally-fitted garments can be brought together. Engineered prints may also be used more subtly to highlight elements such as cuffs, collars and bodices.

There are a number of computer programmes that provides a variety of drawing, painting, rendering and wide range of colour pallette. Adobe Photoshop and Adobe Illustrator have been identified as the most appropriate software for digital textile designing. However, there are other software such as Corel Draw X6 and Adobe InDesign.

Design possibilities are seemingly endless with inkjet printing. Interfering and overlaid abstract patterns that were very difficult to print with conventional printing have become fashionable thanks to inkjet printing. In conventional printing, such patterns have to be separated and rastered at great expense and then printed with a high degree of precision. This places high demands on the entire process. However, inkjet technology has become increasingly important for fashionable textile printing. And this is due to more capable printers and more cost-efficient processes, inkjet printing is currently experiencing a huge boom and developing into a production process. Even though, there have been some queries with the 'flat' outcome of digital prints; the surface and tactile qualities created by traditional print methods are often lost. New

ways to put back these tactile qualities into the creation of fabric are evolving through physical intervention such as over-printing and embellishment. The following processes have been identified as effective ways of dealing with the concerns above. These techniques can be combined with digital print to re-engage the designer with the cloth in other to create beautiful and innovative surfaces. Hand printing and digital printing; Screen printing and digital printing; Devore and digital printing; Foiling and flocking with digital printing; Resist dyeing and digital printing; Embroidery, embellishment and digital printing; Digital printing on conventional design.

Development in the area of digital printing has been actively progressive taking into to meet up with operational deficiencies encountered earlier and the success rate has been very phenomenal. Figure 1 gives a recent assessment of the market which has a growth rate in the region of 20% per year and, if estimates for digital textile production in China were included it would be approaching the one billion square mark of digital textile production by 2016. Figure 1 Digital Textile Print Production in Millions of Square Metres and Future Forecast (Excluding Chinese Digital Production)
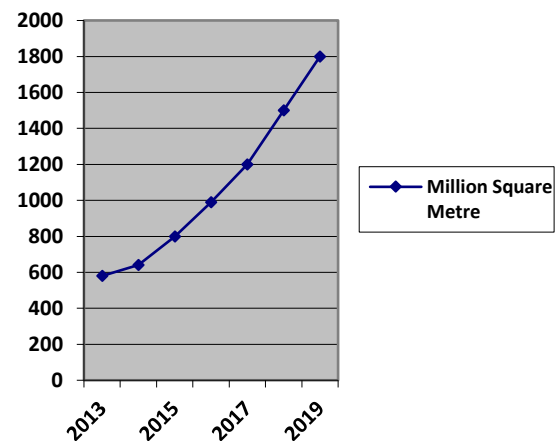


Source: Provost Ink Jet Consulting Ltd

## 5. CONCLUSION

The digital inkjet market for textiles has increased significantly since the introduction of digital textile printing machines with industrial print heads in 2011. The digital textile printing market was given a further boost in production levels with the introduction of the first 'single pass' production machine, using the Kyocera KJ4B print heads by MS of Italy in 2012, the MS LaRio machine which has production speeds up to 75 linear metres per minute. This production speed is achieved by using print bars containing linear arrays of the print heads. From the study, it is evident that digital textile printing has not made much impression in Ghana yet, except for few companies that do some form of T-shirt printing. Working in various design software such as Photoshop, Illustrator, Corel Draw and several others, designs can be recreated in simple geometric shapes, complex motifs, and unlimited colours can be blended to give a rich and exotic feel. Digital textile designs can be dynamic, exciting and reminiscent of ethnic textiles, retaining the luminosity of batik printing but with a contemporary twist. Digital textile printing can

be tweaked in several forms to replace the traditional techniques of hand-dyed batik used in African textiles with digital media. This is because the design and printing possibilities are endless. Furthermore, there is the development of high-speed production single pass digital textile machines and this will speed up the printing cycle three times more than current speeds.

This paper has been an exposé that biased modern digital textile printing against conventional screen printing. This first in the series considers production advantages of digital printing and make a case for its consideration by small to medium scale textiles printers in Ghana. Subsequent studies will look at acquisition, cost implication, energy needs, installation, operation and technical support, staff needs and more importantly sustainability of digital textile printing. Also with the current challenge the main textile factories are facing from pirated imported textiles, innovation in bespoke designs is the way to go and the digital textile printer will be a positive investment in this regard.

**References**

Bowles M. & Isaac, C. (2012). *Digital Textile Design*. 2nd ed. London – UK: Lawrence King Publishing. p2-56.

Faine, B. & Blake, P (1989). *The New Guide to Screen Printing*. United Kingdom: Headline Book Publishing.

Fish, J. (2005), *Designing and Printing Textiles*, Ramsbury – Marlborough, UK. The Crowood Press.

Gilmour, P. (1986). *Ken Tyler, Master Printer, and the American Print Renaissance*. USA: Hudson Hills Press Inc.

Grassel, E. & Schirmer, B., (2006). The use of volunteers to support family careers of dementia patients: results of a prospective longitudinal study investigating expectations towards and experience with training and professional support. Journal for Gerontology and Geriatrics 39 (3): 217-226 Jun.

Gulsecen, S. & Kubat, A., (2006). Teaching ICT to teacher candidates using PBL: A qualitative and quantitative evaluation. *Educational Technology & Society*, 9 (2): 96-106.

Henning, R. (1994). *Screen Printing: Water-based Techniques*. USA: Watson-Guptill Publications Inc.

Horrocks A. H. & Anand S. C. (2004). *Hand Book of Technical Textiles*. Cambridge – UK. Woodhead Publishing Limited.

Mara, T. (1979). *Manual of Screen Printing (The Thames & Hudson Manuals)*. London: Thames & Hudson Ltd. p47-88.

Mazharul, I. K. (2014). *Faults/Defects/Problems, Causes and Remedies of Screen Printing*. Available: http://textilelearner.blogspot.co.uk/2013/06/faultsdefectsproblems-causes-and.html. Last accessed 2nd Feb 2015.

Mcqueen, R. & Knussen, C. (1999), *Research Methods in Psychology: a practical introduction*. Europe: Prentice Hall.

Provost, J. (2015). Print Head Developments - The Key Component that Drives the Increasing Growth in the Digital Textile

Printing Industry. *The Colourist*. Issue 1 (1), p10-12.

Sarantakos, S. (2005), *Social Research Third Edition.* Melbourne: Macmillan Education.

Tellis, W. (1997). Introduction to Case Study. *The Qualitative Report*, Volume 3, Number 2, July. (http://www.nova.edu/ssss/QR/QR3-2/tellis1.html).

Vasilachis de Gialdino, I. (2011). Ontological and Epistemological Foundations of Qualitative Research [85 paragraphs]. Forum Qualitative Sozialforschung / Forum: Qualitative Social Research, 10(2), Art. 30, http://nbn-resolving.de/urn:nbn:de:0114-fqs0902307. (Accessed: 14-02-2014).

**What Appropriate Student Information Will Enable Course Directors To Be Efficient At Helping Students In Need Of Support?**

**J. Bonney\* and W. Kallai**
Koforidua Polytechnic
Department of Mechanical Engineering
Koforidua
E-mail: j700bonney@gmail.com

**Abstract**

A survey was conducted amongst course directors having responsibility for student progression and retention issues. The research was conducted to explore what might be the relevant student information to be contained within an automated student information system accessible to course directors. Completed questionnaires were returned by 44% of the course directors. The responses show that course directors at the Faculty of Engineering Science and Built Environment (FESBE) would like an automated student information system developed which will not only enhance their function as course directors but also enable them to document any advice given to students. 80% of the course directors also agreed to help with the development of a student diagnostic system.

The literature shows that incorporating an Early Warning System into the student information system will help course directors to identify students who might need help early in the semester instead of the traditional end of semester when it is too late to help failing students.

**Key words**: Automation, information system, early warning system, advice, course director

**1.0 INTRODUCTION**

A student record as defined by the National Centre for Education Statistics is any written information about a student. It can be described in terms of the contents (e.g., courses taken, grade point averages), used and e.g., identifying students eligible for the free bursary etc. (National Centre for Education Statistics (NCES), 2007). Typical contents may include personal details of students, courses taken and grades, special program participation information, assessment scores, extracurricular activities, and other information that is used by the education system to promote student success and provide appropriate services.

The contents of the student record are determined by the uses of the records, thus this research is seeking to achieve the following objectives:

- Provide ground work for establishing a student information system for course directors which is easy to use and contain relevant student data for FESBE's Engineering courses, including the identification of problematic students and the pastoral care issues offered by course directors to students.
- Identify a cheaper and easy to manage student diagnostic system which appears to have been successful in improving student mentoring and thus better progression and completion rates.

This study will help to create a unified student information system in FESBE accessible to course directors. The rationale is to ensure that staff engaged with improving the student learning experience can quickly and easily access relevant student information about progress of learning when required. This will enable speedier administration of appropriate decisions for students who may need support and therefore enhance the student learning experience and success.

London South Bank University enrols approximately 20,775 students and 48% of the students attend classes on a part-time basis (LSBU News achieves, 2007). Students are a mix of traditional and non-traditional age students. Many of the students who apply for the first time to any of the departments are adults who have been out of school for several years. These non-traditional students usually hold part-time or full-time jobs in local industry and are highly motivated in earning a degree.

In Britain the indicator used in the Further Education sector to measure student retention is the relative economics and social deprivation of the electoral ward where a student lives (Hanover Research, 2011); Martinez, 2001). Davies and Rudden, (2000) have demonstrated that social deprivation measured in this way correlates poorly with retention and achievement across the college sector.

In the USA most universities have adopted cheaper ways to use student attendance and other easily available student information from unit lecturers/ tutors to identify students on time who may need help with their studies to prevent them falling behind. The method is termed "Early Warning System" (Navarro College, 2015); (Shippensburg University Office of the Registrar, 2006); (University of South Carolina, 2015) and (University of

Wisconsin, 2015**).** Such retention practice also known as Early Interventions (EI) is designed to minimise attrition/absenteeism by concentrating on singular programs or services, chiefly in the domain of academic services (McClanahan, 2004). This practise is in line with the objective of this research project to enhance the efficiency of course directors at Engineering Systems Department as student mentors.

An automated "Early Warning System" is designed to identify, report, and provide feedback for students who are identified by instructors as having academic difficulties. The lecturer or tutor has the sole responsibility to monitor the student progress during the early weeks and throughout the semester. She or he notifies the appropriate authority (course director) stating the appropriate reasons. This can include poor academic work, non-participation in group work, poor attendance, in-complete assignments, projects, portfolios, and other evaluation components of units/ laboratory work etc.

The student information required on the Early Warning form is simplified to enable quicker completion by lecturers/tutors. A typical Early Warning form is shown in Appendix B (University of Wisconsin, 2015). The automated forms are completed online by the lecturer at set periods during the semester and sent out to the appropriate authority (course administrator). The information is filled in automatically into the student information system by a click. The Early Warning System therefore serves to provide the department with the opportunity to identify student who may be in need of support or is about to withdraw from the course if she/he does not attend to lessons.

Students having difficulty in the course have a personal appointment with the course directors to discuss how she/he may be able to remedy the situation. Where the course director cannot help, the student is directed to contact the appropriate support system in the university. Students tend to learn effectively when good support systems are there to help them with the transition between the academic world and their previous experience (Jones *et al.,* 1997). Assisting students in overcoming academic deficiencies can lead to student success. For the system to function efficiently all lecturers/tutors must participate and should turn in the early alert as soon as possible and not wait until near the end of the semester. Also participating lecturers should not consider this as extra work.

The advantages of a student information system for course directors that is appropriately aligned with the Quality Learning System (QLS) of FESBE can influence the quality of counselling and the decision making process by course directors in relation to offering the right advice to the student. Successful decisions about students can be achieved by the use of effective information on students. A comprehensive student information system for course directors can provide the following:

- Good decisions based on inquiry and analysis of student data (Information technologies are available to make good decision making possible for

course directors and administrators alike).

- Timely and accurate data about students can help decision making at early intervention to prevent student fall- out from the university.

- Improvements in administrative efficiency and time management can be significant.

The relevant information extracted from this research will serve to establish standard student information for course directors at Department of Engineering Systems that will ensure the following basic characteristics:

- Understandability

## 2. RESEARCH METHODOLOGY

Survey methodology was employed for this research project. The survey methodology was designed to maximise response rate and to minimise time demands. This was appropriate as the participants are course directors who are in regular contact with students enrolled on the various FESBE courses and therefore have a working knowledge of the pertinent issues relevant for students.

In this study, descriptive survey was used for the purposes of examining perception and the level of awareness by course directors on relevant student information needed to improve and support the students during their study. Descriptive surveys have the capacity to generate a reasonable number of responses from which it is possible to make well substantiated generalisations about the information needed to be contained in the student record system.

- Reliability
- Relevance
- Consistency

The usefulness of the student information system for course directors will improve the quality of student learning and therefore raise the student retention rate. Questions of appropriateness, privacy, and ethics need to be resolved. The Data Protection Act, (1998) requires that certain types of information (e.g., individual student and staff records) be protected from unauthorized use. This information system should achieve a balance so that under the best circumstances, the quality of data is more useful for the purpose for which it was intended.

Van Maanen, (1979), states that "a qualitative research is an umbrella term conveying an array of interpretation techniques which seek to describe, decode, translate and otherwise come to terms with the meaning, not the frequency of certain more or less naturally occurring phenomena in the social world".

With descriptive analysis, the raw data is transformed into a form that will make it easy to understand and interpret (Zikmund, 1994). In view of the nature of information required, the research primary data was produced through the use of a survey Questionnaire as this was easily and cheaply distributed to course directors located in the same block of university building.

This approach has the ability to focus attention on aspects of student's information required for the record system, and thus guides the respondents thought in a logical progression,

from one question to the next. It was important to ensure that the questionnaires contained both open and closed questions. Opie, (2004), states that "open questions allow free response and no preconceived replies (unless the question is worded badly) are imposed by the researcher". The advantage is additional information for the researcher but special care was needed in the wording of the questions in the questionnaire to make it simple and easy for the participants to understand.

The disadvantages of the use of questionnaires according to Dillman, (1975) are the low response rates, inability to probe respondents, and the length and complexity of completing the questionnaire. Thus, in developing the questionnaire, due care was exercised to minimise these disadvantages were possible.

Based on the London South Bank University (LSBU) and Universities and Colleges Admission System (UCAS) application forms a questionnaire was created to collect the appropriate information that course directors would like included in the student information system. The questions on the application forms are also contained in the University Quality Learning System (QLS). This student record system was implemented by LSBU in 2003. It contains student admissions data as well as the financial status of the student (fees, grants etc.). Figure 1-2 are typical forms used for inputting student data into the QLS system. The system also contains information about first and second semester assessment results. The administrative rights to the QLS are owned only by the Course Administrators; hence any student information required by course directors has to go through the course administrator which means valuable time is lost when dealing with student problems. Most of the information the course directors wanted available on their system is also contained in the QLS and these can easily be modified to suit the information system required by course directors.

The research reported in this study was limited to course directors at FESBE which is made up of Design, Engineering and the Built Environment departments. The focus was on Engineering because of the time lines hence course directors from the Faculty of Arts were not considered. There were a total of 32 course directors who were all sent questionnaires.

Of the 32 questionnaires sent out to course directors, only 14 (44%) were returned. This is in agreement with what Dillman, (1975) stated that the response rate is low for data collected by means of questionnaires. This low response rate was not anticipated as high participation was expected by course directors whom had been contacted earlier. Owing to the limitations of time, certain assumptions were made, in relation to the raw data received which are:

- that all the information given is a true reflection of the responses from course directors in the faculty (FESBE);
- that all the answers given to the questions in the questionnaire were honest answers.

**Figure 1**: Student admissions details form used on the QLS



**Figure 2**: Student assessment record details used on the QLS

## 3. RESULTS ANALYSIS AND DISCUSSIONS

Analysis of the returned questionnaires shows that 57% of the respondents are responsible for undergraduate students while 43% are responsible for postgraduate students. None of

the course directors have responsibility for both undergraduate and postgraduate students. Figure 3 is a pie chart showing the number of years that the respondents have responsibility as course directors. The pie chart shows that the time served by course directors varies from 3 months to a maximum of 12 years. Most of the respondents (44%) have served for at most two years. This shows that the course directors post is dynamic and the responsibility can go to any academic staff when the need arise. This means the experiences of course directors acquired by working as student mentors varies considerably. Those with longer service may have a wealth of knowledge which could be utilised by all course directors.
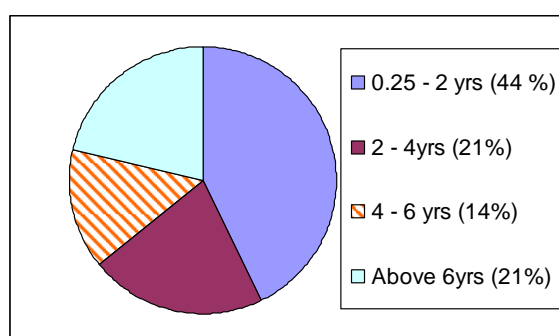


Figure 3: Number of years responsible as a course director.

Two of the respondents wanted all information affecting students' progress included in the course directors' information system. This will include documenting details of advice given to the students as well as the outcomes. This will provide a library of information for a new course director who will be responsible for the

course and students in the future. It will provide a template from which to draw analogies in providing guidance to student with similar or cases which are closer. As noted by Jones, (1997) "lecturers can provide students with the help that they need, and in order that they can protect themselves from accusations that they have failed to provide appropriate help, it is important that adequate records are kept of pastorial and other non-teaching interactions with students, including discussions about progress and personal problems". Privacy is very important and all the information contained in the system will be governed by privacy laws which the University subscribes.

The response to Q3 "How often would you like your students to contact you during the semester?" The response varies from every week to as and when the student require.
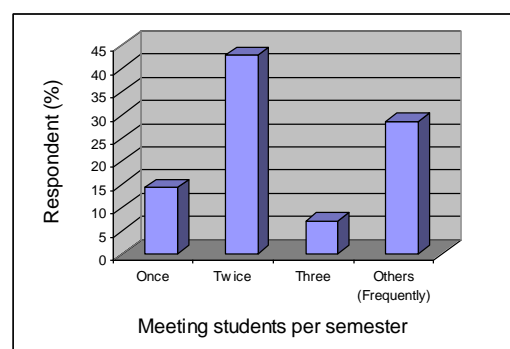


**Figure 4**: Number of times course directors prefer to meet students

Figure 4 shows that 42.9% of course directors prefer to meet students twice during the semester, while 28.6% prefer "as and when the student requires (frequently – more than three times during the semester)". Frequent meeting

the course director by students will foster a better relationship that will enable the student to confide any problems there may be. The most frequently cited problem for mentees was lack of time with mentors (Ehrich *et al.,* 2002).

Other information given by course directors to be included in the student information system are: marks for all units, financial status of students, enrolment information including mitigation circumstances as well as contact details of the student.

**Table 1**: Questions with yes or no answer and percentage YES response

| Questions | Yes % | No % |
|---|---|---|
| Q4. Would you like to have a student record system that will provide you with instant student information when required? | 100 | 0 |
| Q5. Would an automated student record system that can allow you to easily access student performance data enhance your efficiency as a course director? | 85 | 15 |
| Q7. Would you consider student attendance information to be appropriate for identifying any student who may need help while on the course / unit? | 71.4 | 28.6 |
| Q10. Would you support the development of a quick student diagnostic testing method that can be used to help identify students who may need academic help? | 64.3 | 35.7 |
| Q11. Would knowing the disability / special need status of a student as early as possible help you to advice / provide the appropriate help to the student? | 85.7 | 14.3 |

Q12. Would knowing the educational background and qualifications    78.6          21.4
    of students help you to identify which help a student might
    need to improve his/her studies?

Table 1 shows responses to questions which require a yes or no answer. All the course directors agreed that there is the need for an automated student record system (Table 1). Some of the benefits which the course director's believe could be achieved from the student information system are as follows;

- Useful to be able to access information on how students are doing overall, rather than having to request the information from the faculty office which wastes time
- Day to day dealing e.g. with external examiners and at exam boards
- The facility to access all marks and attendance data at one place would make tracking of students' progress easier
- Overall performance record to enable better understanding of students background when meeting them
- Easier to deal with students unknown to the course director

This research has shown that there is the need for a new and efficient way of keeping student records instead of relying on manual paper method. When the course directors where asked whether an automated student record system will enhance their performance, two answered "don't know", but thought course administrators are also responsible for student mentoring.

About 36% of the respondents did not see the need for any diagnostic testing method as they are not prepared to commit to helping with its development. It is interesting to note that those who agreed with developing a diagnostic testing method to act as an early warning system to help support students with their studies thought testing students in basic Mathematics and English language could provide a better indication of the level of help the student may require. The literature shows that there are computer diagnostic methods for English language, mathematics and other subject including engineering and science based on student answering objective type questions (Gustafson, 2003); (Hwang, 1999). Most of the course directors also agreed that diagnostics based on attendance, non-submission of assignments, attitude at lecture or practical laboratory work can also be used. The success in using the diagnosis based on the above depends much more on the co-operation between unit lecturers/teachers and the course director. The lecturer has the responsibility of monitoring the student progress at regular intervals which adds to her/his work load. The Early Warning System used by universities in the USA relies on the lectures to provide the necessary feed back to the appropriate authority (Navarro College, 2015);

(**Shippensburg University, 2015);** (**University of South Carolina, 2005);** and (University of Wisconsin, 2015). This system is easy and cost effective to implement and it will help improve the quality of student mentoring activities provided by course directors at the Engineering Systems Department.

Monitoring student attendance was considered by the course directors as one of the major ways to help monitor the student's progress. The least number of absences from class ranges from 2 to 4 consecutive lessons before action could be taken. One respondent agreed that this decision will also depend on the unit being taught e.g. A student who misses a couple of laboratory work may not pass the unit. This is because it is usually expensive to set up laboratory work for individuals, the decision will depend on the unit tutor.

The technology is also available to monitor student attendance at lessons automatically.

Students can be registered when they swipe their student ID cards. This could be achieved by installing mini card readers in all the classrooms. The lecturer will have to set the unit code to activate the registration of any student who swipes their ID cards. This can be linked into the student information system to maintain the records. Any one responsible for student progress can easily access this data.

Table 2 shows the ranking to the student personal response information. The scores are obtained as the sum of all the rankings allotted to each question by the course directors. The student information with the highest ranking score of 98 is "Reason for choosing course" and the student information with the least ranked score of 66 is "The positions of responsibility you have obtained through your work and or education which might be relevant to the award/course" (Table 2

**Table 2:** Ranking type questions for Q13

| Questions | Score |
|---|---|
| Reason for choosing course | 98 |
| Future career plans | 91 |
| Financial situation | 90 |
| The knowledge you have obtained through your work and or education which might be relevant to the award/course. | 85 |
| The challenges facing you in your studies, work or personal career development. | 85 |
| The skills you have obtained through your work and or education which might be relevant to the award/course. | 84 |

The work experiences and / or personal developments which have been most important to you.      76

The positions of responsibility you have obtained through your work and or education which might be relevant to the award/course.      66

---

## 4.CONCLUSIONS

1. The research project has shown that all the course directors at Engineering Systems Department are in favour of having a student information system which can help to enhance their role as course directors.

2. The university already has the QLS system which contains most of the student data required by course director. This can be modified to be used by course directors.

3. The student information system for course directors should include additional record sections where student counselling information and their outcomes as well as meetings could be recorded

4. Diagnostic testing to identify students who might need support was considered useful but the development of such a system will not be supported by all course directors.

5. Early Warning Systems used by universities like Shippensburg University is effective in improving student performance by helping students who may need support on time and therefore improve student retention. The EWS will be useful if integrated into the student information system for course directors at FESBE.

**References**

Data Protection Act (1998). http://www.legislation.gov.uk/ukpga/1998/29/data.pdf, (Accessed 2 February 2015)

Davis, P., Rudden, T. (2000). Differential achievement: what does the ISR profile tell us? Learning and Skills Development Agency (LSDA) Report

Dillman, D. A., and Frey, J. M. (1975). "Contribution of Personalisation to Mail Questionnaire Response as an Element of a Previously Tested Method", Journal of Applied Psychology, Volume 59

Ehrich, L., Tennent, L., Hansford, B. (2002). A review of mentoring in education: some lessons for nursing, Contemporary Nurse, Vol. 12, pp 253-264

Martinez, P. (2001). Improving student retention and achievement: what do we know and what do we need to find out? Learning and Skills Development Agency (LSDA) Report

National Centre for Education Statistics (NCES) Building an Automated Student Record System: A Step-by-Step Guide for

Local and State Education Agencies, http:// nces.ed.gov/pubs 2000/ 2000324. pdf. (Accessed 2 April 2007).

**Navarro College, (2015). Early Warning Referral System,http:// www. navarrocollege. edu/ faculty/ early-warning/ (Accessed on 2 February 2015)**

Opie, C. (2004). Doing educational research: A guide to first time Researchers. London: Sage

Shippensburg University, Academic Advising, Early Warning System, (http://www.ship.edu/AdvisingArchive /Student_Resources/Early_Warning_Syst em_FAQs (Accessed on 28 March 2015)

University of South Carolina, National Resource Centre, ((2015). Early Warning Systems http://web.usca.edu/asc/early-warning/earlywarningform.dot (Accessed, 28 April 2015)

University of Wisconsin, UW-Milwaukee, Early Warning System, (2015). https://www4.uwm.edu/faculty_staff/in structional_support/early_warning.cfm (Accessed 28 April 2015)

Van Maanen, J. (1979). Reclaiming qualitative methods for organizational Research: A preface, Administrative Science Quarterly, Vol. 24, No.4, pp 520-526

Zikmund, W.G. (1994). Exploring Market Research. Chicago: Dryden Press, USA.

## Levels of Organochlorine Pesticide Residues in Cocoa Beans from Ashanti and Brong Ahafo Regions of Ghana

**Boakye Sandra*[1], Jonfia-Essien William[2], Voegborlo Bright Ray[3], Owusu Boadi Nathaniel[3]**
[1]Radford University College. Department of Applied Science Accra Ghana
[2]Quality Control Company Ltd, (COCOBOD). P. O. Box M54. Accra;
[3]Kwame Nkrumah University of Science and Technology. Department of Chemistry, Kumasi
*Email: sanance1@yahoo.com

**Abstract**

The monitoring of pesticide residues in food has become a priority objective worldwide in order to get an extensive evaluation of food quality and to avoid harm to human health. This study presents results of analysis conducted on four pesticide residues in cocoa beans sampled from the Brong Ahafo and Ashanti Regions of Ghana. The pesticides were extracted from cocoa beans using liquid- liquid extraction followed by clean up with solid-phase extraction cartridges. Final extracts were dissolved in ethyl acetate and analysis carried out by Gas Chromatography with Electron Capture Detector. Pesticides were identified by their retention times and quantification using an external calibration method. From the results it could be deduced that 92.5 % of the pesticides residues detected in both regions were below the EU and Japanese allowable limits. Endosulfan I had high residual concentrations for cocoa beans found in Berekum, Hwidiem, Brofoyedru and Ampenim samples. Endosulfan II exceeded permissible levels for Goaso and Ampenim samples. However DDT and DDD were found to be below Maximum Residue Limits established by EU and Japanese organizations in all samples.

**Keywords:** Pesticide residues; Maximum residue limits; Cocoa beans; Retention times; Gas chromatography

## 1. INTRODUCTION

The main cash crop in Ghana is cocoa and the country currently has annual production of around 850,000 metric tonnes (ghanaweb.com, 2013). Cocoa represents around 30% of Ghana's total export earnings and it is the second most important export commodity after gold (ICCO, 2006). Cocoa serves as the major source of revenue for the provision of socio-economic infrastructure in the country (Anon, 1995). In terms of quality, Ghana is recognized as the world leader in premium quality cocoa beans production and the quality of Ghana's cocoa has been a benchmark for assessing cocoa from other countries (Osei, 2008).

Cocoa is affected by a range of pests and diseases, with some estimates putting losses as high as 30% to 40% of global production (ICCO, 2008). Pests and disease problems which are of concern in cocoa production in Ghana include the cocoa swollen shoot virus, capsids, insect pests of the cocoa tree (termites and stem borers), weeds and insect pests of storage such as beetles and warehouse moths (ICCO, 2008). To minimize the economic losses caused by these pests and diseases in the cocoa industry; various pesticides and herbicides are used on cocoa on a massive scale (Hayes and Laws, 1991). In Ghana, the majority of pesticides used in agriculture are employed in the forest zones located in the Ashanti, Brong Ahafo, Western and Eastern Regions of the country (Amoah et al., 2006).

Organochlorine pesticides (OCPs) are very stable solids with limited vapour pressure and very low water solubility. The hazardous nature of organochlorines is a result of their toxicity in combination with high chemical and biological stability and a high degree of lipophilicity (Biziuk et al, 1996). These aforementioned characteristics make the Organochlorine pesticides prone to bioaccumulation along the food chain involving a wide range of trophic levels. Research data available have indicated the presence of pesticide residues in dairy products, meat (Darko and Acquaah, 2007, 2008) fish, water, sediments (Darko and Acquaah, 2008), human blood and breast milk (Ntow, 2001), fruits and vegetables (Hanson et al., 2007; Hussain et al., 2002; El-Nahhal, 2004). It has been reported that, in 1978, data submitted to the Food and Agricultural Organization / World Health Organization (FAO/WHO) indicated that the levels of lindane in cocoa beans from Ghana were between 0.0 and 0.3 mg kg$^{-1}$ and between 0.051-0.10 mg kg$^{-1}$ in cocoa butter. The residue in cocoa mass was 0.038 mg kg$^{-1}$ which was below the established FAO/WHO maximum residue limit of 1.0 mg kg-1 (FAO/ WHO, 1978).

Recently, there have been some complaints about high levels of chemical residues in cocoa beans. Standards and regulations for the export markets have increased over the last decade dramatically in number and stringency in response to food, health and environmental safety leading to the establishment of maximum residue limits (MRLs). MRLs encourage food safety by restricting the

concentration of a residue permitted on a commodity, and by limiting the type of commodity in which it is allowed (European Communities, 2005; FAO/UNEP/WHO, 1991; FDA, 2005). Monitoring programs have therefore been established to control pesticide residues in food of plant origin in order to ensure compliance with national and international laws, and to reassure consumers that food crops are safe and healthy. Since Ghana is one of the leading cocoa exporters worldwide, it is therefore necessary to monitor the levels of pesticide residues in cocoa beans to determine whether the quality of cocoa beans produced in Ghana conforms to international standards.

## 2. METHODOLOGY

### 2.1 Sampling

Dry cocoa beans were sampled from Produce Buying Company warehouse in January 2010 where cocoa beans from different districts of the Ashanti and Brong Ahafo Regions of Ghana were received. At the moment, the high cocoa producing areas are Western, Ashanti and Brong Ahafo regions with the western region leading production figures. However western region was not selected due to bad roads and unfamiliar terrain hence Ashanti and Brong Ahafo regions been the next highest were selected.

The consignment was divided into smaller lots and the split wire was applied as widely as possible to detect foreign matter. A sampling horn was used to draw samples from top, bottom and sides of each cocoa bag and bulked into a container. The bulked sample was thoroughly mixed and quartered. Two quarters of the opposite sides were rejected. The process was repeated until a final sample of 300 beans was counted into bags. One of the bags containing the 300 beans was sent to the laboratory for analysis (Quality Control Division, 1994).

### 2.2 Reagents and apparatus

Acetonitrile, acetone, ethyl acetate and toluene were pesticide grade (BDH, England). Acetone, dipotassium hydrogen phosphate and potassium dihydrogenphosphate were analyt grade (BDH, England). Sodium sulfate was pesticide grade (Aldrich- Chemie, Germany), sodium chloride (Pesticide grade, Riedel-de Haen), Envi-carb/LC-NH$_2$ (500 mg/500 mg/ 6 mL) from Supelco C-18 (USA).

### 2.3 Experimental Procedures

Before analysing the samples all glass wares were acid washed and cleansed with distilled water and dried in the oven at 200 $^{\circ}$C for about four hours.

### 2.4 Analysis for pesticides

Sample preparation, extraction, clean-up and analysis were carried out according to the procedure described in multi-residue method for agricultural chemicals (Syoku-An, 2006).

### 2.4.1 Sample extraction

The extraction procedure describe below was adapted from Japanese analytical method for multi-residues for agricultural chemicals (Syoku-An, 2006). 10 g of cocoa beans were thoroughly ground and about 20 ml of distilled water was added. It was stirred to form a homogeneous mixture and allowed to stand for 15 minutes. An amount of 50 ml acetonitrile was added and macerated for 2 minutes. It was centrifuged

(Sanyo (MSE) Harrier 18 / 80, Japan) at a speed of 3000 rpm for 3 minutes and filtered through Whatman No. 4 filter paper into 100 ml volumetric flasks. An amount of 20 ml acetonitrile was added to the residue and homogenization process repeated for 2 minutes. The jar was rinsed with 15 ml acetonitrile and residue, filtered and all filtrates adjusted to the 100 ml mark with acetonitrile. An aliquot of 20 ml was pipetted into a 250 ml separating funnel. 10g of NaCl and 20 ml of 0.5 mol/L phosphate buffer (pH 7.0) were added. The separating funnel was corked and shaken for 20 minutes using the electronic shaker (BS-GS-10 CN-ZHE, China) and allowed to stand for another 10 minutes. The organic layer was transferred into 50 ml beaker for further clean-up.

## 2.4.2 First Clean-up using Bond Elute C-18 cartridges

Bond Elute C-18 (1000 mg/6 ml) cartridge was conditioned with 10 ml acetonitrile. A receiving flask was placed under the cartridge to collect elute. Approximately 20 ml of the sample extract was loaded into the cartridge and eluted with 2 ml acetonitrile. An amount of 5 g $Na_2SO_4$ was placed on a filter paper in a funnel and the extract dried over it. The container was rinsed with acetonitrile and passed through the $Na_2SO_4$. The sample solution was transferred into 50 ml round bottom flask and evaporated at 40 °C to dryness on a rotary evaporator (Bucchi India). Residue was dissolved in 2 ml of 1:3 (Toluene: Acetonitrile)

## 2.4.3 Second clean – up using ENVI -Carb/LC – NH₂

ENVI – Carb/LC – NH₂, (500 mg/500 mg)/6 ml cartridge was conditioned with 10 ml of 1:3 toluene: acetonitrile. The 2 ml extract from the previous clean – up step was loaded into the cartridge and eluted. The cartridge was eluted with 20 ml of 1:3 (toluene: acetonitrile). The sample solution was transferred into a 50 ml round bottom flask and evaporated at 40 °C to approximately 1 ml by rotary evaporator. An amount 10 ml of acetone was added to the flask and was concentrated just to dryness.

The extracts were re-dissolved in 2 ml ethyl acetate in vials and 0.5 ml used for injection. Quantification was achieved by gas chromatography analysis using electron capture detector (Shimadzu GC - 2010, Japan).

## 2.4.4 Quantification of Pesticide Residues

The residue levels of organochlorine pesticides were quantitatively determined by the external standard method (Chung et al, 2010) using peak areas. The peak areas whose retention times coincided with the standards were extrapolated on their corresponding calibration curves to obtain the concentration. Details of chromatographic conditions are shown in Table 1.

**Table1. Summary of chromatographic conditions for pesticides analyses**

(a) **Description of instrument**

| Instrument | Description |
|---|---|
| Gas Chromatograph | Shimadzu GC – 2010 with AOC 20 I Autoinjector and AOC 20 S |

| | Auto sampler and Electron Capture Detector |
|---|---|
| Analytical column | 30 m x 0.25 mm internal diameter fused silica capillary column coated with VF-5 ms (0.25 μm film). |

**(b) Temperatures**

| Item | Conditions |
|---|---|
| Injector | Splitless mode, temperature 225 ° C |
| Oven | 60 °C / 2 min 25 °C/1min 180 °C / 1min 5 °C /1 min 300 °C |
| Detector – ECD | 300 °C |

**NOTE:** Nitrogen was used as the carrier gas and was maintained at a flow rate of 1 ml/min

**2.4.5 Quality control and quality assurance**

Quality of pesticides was assured through the analysis of solvent blanks, matrix blanks and duplicate samples. All reagents used during the analysis were exposed to same extraction procedures and subsequently run to check for interfering substances. In the blank for each extraction procedure, no pesticide was detected. Sample of each series was analyzed in duplicates. The method was optimized and validated by fortifying the ground and homogenized cocoa beans sample with 500 μL of 1.0 μg/mL pesticide standards mixture before analysis to evaluate the recovery of compounds. The recoveries of internal

standards ranged between 67 % and 130 % for most of the pesticides analyzed.

**2.4.6 Data Analysis**

Concentration of OCPs in cocoa bean samples injected was recorded in ug/ml. To obtain the concentration of OCPs in mg/kg, the formula below was used.

$$\left\{\left[\frac{C}{F}\right] \times 5\right\}/M$$

Where C=concentration in ug/ml

F= Concentration Factor (10)

M = mass in grams

**2.4.4 Recovery**

An aliquot of Standard mixture 1 (MIX 1) which comprised of mixture of pesticides standards was added to 20 g of an aliquot of a prepared matrix (1ml = 20 μg of each analyte). This is equivalent to a fortification level of 1 mg/kg. Extraction and clean – up procedure as in the methodology were carried out before its injection into the GC. Same chromatographic conditions were used. This was repeated for fortification levels of 0.5 mg/kg and 0.2 mg/kg.

The percentage recovery was calculated as:

$$\% \text{ Recovery} = \frac{\text{Amount of analyte recovered}}{\text{Amount of analyte spiked}} \times 100$$

**3. RESULTS**

Pesticide residues identified in the cocoa beans were DDT, DDD, endosulfan I and II. Each pesticide corresponded to that obtained from the standard mix chromatogram (Fig. 1 and Fig. 2). Fig. 3 is a profile of a cocoa sampled from Offinso in the Ashanti region. The retention

times of individual pesticides obtained from the chromatogram are shown in Table 2.



**Figure1**. Chromatogram for pesticide standard mix for DDT and DDD



**Figure 2**. Chromatogram for pesticide standard mix for endosulfan



**Figure 3**: Chromatogram for cocoa beans from Offinso in Ashanti region

**Table 2.** Retention times of Organochlorine Pesticide standards

| Standards | Retention Time (Min) |
|---|---|
| Endosulfan I | 19.621 |
| Endosulfan II | 21.535 |
| DDD | 21.990 |
| DDT | 23.348 |

Dichlorodiphenyltrichloroethane (DDT) and its metabolites were detected in 100 % of the analysed samples. For DDT, the lowest concentration was 0.08 mg/kg  and was recorded for cocoa beans from Sunyani and Nyinase A and the highest concentration was 0.46 mg/kg which was recorded for cocoa beans from Asumura. The mean concentration for DDT was 0.28 mg/kg (Table 3).

Levels of dichlorodiphenyltrichloroethane (DDD) present in cocoa beans in Brong Ahafo region ranged from 0.03 mg/kg for cocoa beans from Sankore, Sunyani, Asumura, Goaso, Mim, Nyinase and Nkrankwanta to 0.06 mg/kg for samples from Nyinase A. The mean concentration of DDD was 0.03 mg/kg (Table 3)

Endosulfan I and II were present in all the cocoa beans sampled from the different locations in the Brong Ahafo region. Concentrations of the endosulfan II residues in cocoa beans in all the sampling areas were lower than endosulfan I.

**Table 3**. Pesticide residues in cocoa beans from Brong Ahafo region

| Name of Pesticide | Mean Concentration (mg/kg) | SD | MRL | | Source of samples exceeding MRLS |
|---|---|---|---|---|---|
| | | | EU | JAPAN | |
| Endosulfan I | 0.07 | 0.03 | 0.10 | 0.10 | Brekum, Hwidiem |
| Endosulfan II | 0.07 | 0.03 | 0.10 | 0.10 | Goaso |
| DDT | 0.28 | 0.30 | 0.50 | 0.05 | None |
| DDD | 0.03 | 0.01 | 0.50 | 0.05 | None |

**NOTE:** Goaso 0.11 mg/kg, Berekum and Hwidiem  0.20 mg/kg

Levels of endosulfan I ranged from 0.01 mg/kg for samples from Sankore to 0.20 mg/kg for cocoa beans from Berekum and Hwediem. The mean concentration was 0.07 mg/kg (Table 3). All the cocoa beans sampled from most of the locations in the Brong Ahafo region had concentrations lower than EU and Japan MRL values of 0.10 mg/kg with the exception of samples from Berekum and Hwediem. Levels of endosulfan II detected in the cocoa beans from the Brong Ahafo region were between 0.04 mg/kg for samples from Sankore to 0.11 mg/kg for samples from Goaso. The mean concentration for endosulfan II was 0.07 mg/kg (Table 3).

**Table 4:** Pesticide residues in cocoa beans from Ashanti region

| Name of Pesticide | Mean Concentration (mg/kg) | SD | MRL | | Source of samples exceeding MRLS |
|---|---|---|---|---|---|
| | | | EU | JAPAN | |
| Endosulfan I | 0.07 | 0.06 | 0.10 | 0.10 | Ampenim, Brofoyedru |
| Endosulfan II | 0.08 | 0.03 | 0.10 | 0.10 | Ampenim |
| DDT | 0.13 | 0.09 | 0.50 | 0.05 | None for EU |
| DDD | 0.03 | 0.02 | 0.50 | 0.05 | None For EU |

**NOTE:** Ampenim 0.16 mg/kg for endosulfan II

**Table 5:** Concentration of pesticide residues in sampling areas of Brong Ahafo region

| Pesticide | SAN | ASU | KUK | SUY | NYI | GOA | BRE | NKR | HWI | MIM | EU | JAP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DDT | 0.15 | 0.46 | 0.24 | 0.08 | 0.08 | 0.17 | 0.11 | 0.19 | 0.20 | 0.22 | 0.50 | 0.10 |
| DDD | 0.03 | 0.03 | 0.04 | 0.03 | 0.06 | 0.03 | 0.04 | 0.03 | 0.02 | 0.03 | 0.50 | - |
| Endosulfan I | 0.01 | 0.05 | 0.04 | 0.04 | 0.04 | 0.04 | 0.20 | 0.06 | 0.20 | 0.06 | 0.10 | 0.10 |
| Endosulfan II | 0.04 | 0.09 | 0.08 | 0.08 | 0.07 | 0.11 | 0.07 | 0.08 | 0.09 | 0.09 | 0.10 | 0.10 |

**NOTE** : SAN –Sankore, ASU – Asumura, KUK – Kukuom, SUY – Suyani, NYI – Nyinase A , GOA – Goaso, BRE –Brekum, NKR – Nkrankwanta, HWI– Hwidiem

In the Ashanti region, DDD residues were not detected in cocoa beans sampled from Ampenim, Nyinahini and Juaso. The highest concentration was 0.05 mg/kg for samples from Brofoyedru and the lowest concentration was 0.02 mg/kg for samples from Nkawie. The mean concentration for DDD residues was 0.03 mg/kg (Table 4). All the samples were within the EU and Japanese MRL value of 0.50 mg/kg and 0.05 mg/kg respectively. In the Ashanti region, DDT residues ranged from 0.02 ppm for samples from Brofoyedru to 0.20 mg/kg for samples from Ampenim and New Edubiase. The mean concentration was 0.13 mg/kg (Table 4).

In the Ashanti region, the levels of endosulfan I in cocoa beans ranged from 0.04 mg/kg for samples from Nkawie and Agona to 0.20 mg/kg for samples from Brofoyedru. The mean concentration for endosulfan I was 0.07 mg/kg (Table 4). There were non-detectable levels of endosulfan I in cocoa beans from Juaso and Apagya. Endosulfan II in cocoa beans ranged from 0.05 mg/kg for samples from New Edubiase to 0.16 mg/kg for samples from

Ampenim. The mean concentration was 0.08 mg/kg (Table 4).

**Table 6:** Concentration of pesticide residues in sampling areas of Ashanti region

| Pesticide | AMP | NYI | MAN | JUA | NEW | NKA | AGO | OFF | BRO | APA | EU | JAP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DDT | 0.20 | 0.17 | 0.0 | 0.10 | 0.20 | 0.09 | 0.04 | 0.08 | 0.02 | 0.07 | - | 0.50 |
| DDD | 0.01 | 0.01 | 0.03 | 0.01 | 0.03 | 0.02 | 0.04 | 0.04 | 0.05 | 0.03 | - | 0.50 |
| Endosulfan I | 0.12 | 0.05 | 0.05 | 0.01 | 0.06 | 0.04 | 0.04 | 0.10 | 0.20 | 0.01 | 0.10 | 0.10 |
| Endosulfan II | 0.16 | 0.09 | 0.07 | 0.07 | 0.05 | 0.08 | 0.06 | 0.07 | 0.08 | 0.07 | 0.16 | 0.10 |

**NOTE :** NYI – Nyinahini, MAN– Mankranso, JUA – Juaso, NEW – New Edubiase. NKA – Nkawie, OFF – Offinso, BRO – Brofoyedru, APA – Apagya, AGO – Agona AMP– Ampenim

## 4. DISCUSSION

In the present study, there were presence of both DDT and its metabolite DDD in the samples though they have been banned in Ghana since 1985 (EPA Ghana, 2008). This could be attributed to the persistence and long range transport nature of DDT and its metabolite DDD (Ritter et al., 1995, Kanan et al, 1994, Parimi et al, 2006). The concentrations of DDT residues in all the cocoa beans from sampling areas in Brong Ahafo region were higher than DDD (Fig. 3). It could be inferred from the trend that there is a continuous use of DDT in the area due to its lower cost and effectiveness as well as its broad spectrum activity despite its ban (Amoah et al, 2006).

**Figure 4**: Mean concentration of pesticide residue in mg/kg in Brong Ahafo and Ashanti regions

Although the food samples were contaminated with DDT and DDD, the maximum residue levels were below FAO's MRL and the standards set by some European countries. The concentrations of DDT found in this survey were lower than those recorded for fresh milk from some developing countries such as, Uganda 3.24 mg/kg, Nigeria 3.83 mg/kg, India 6.55 mg/kg, Kenya 6.99 mg/kg, South Africa 20.10 mg /kg and Ethiopia 7.75 mg /kg (FAO, 1986).

For endosulfan I, all the cocoa beans sampled from most of the locations in the Brong Ahafo region had concentrations lower than EU and Japan MRL values of 0.10 mg/kg with the exception of samples from Berekum and Hwediem. A research conducted by Frimpong et al, (2012) revealed that the mean endosulfan I residue concentration in cocoa beans from

Tema warehouse to be 16.7 ± 6.8 µg/kg which was lower than the results obtained in this study. Endosulfan I residues have also been recorded in crops and in fish in Ghana (Ntow, 2001; Osafo and Frimpong, 1998). An appreciable concentration of a endosulfan I was measured in the breast milk samples of human beings (Ntow, 2001). However endosulfan I is considered for restrictive use in Ghana (EPA, 2008).

All samples analysed for endosulfan II for Brong Ahafo region were within the EU and Japanese MRL values of 0.10 mg/kg with the exception of samples from Goaso which had concentration of 0.11 mg/kg, which is slightly above the set limit. A study by Frimpong et al, 2012, on endosulfan II residues in cocoa beans indicated mean concentration of 9.4 ± 4.8 µg/kg which was lower than the results obtained in this research.

Out of the number of samples analysed for DDT residues in the Ashanti region, 80 % were above the Japanese MRL of 0.05 mg/kg except cocoa beans from Agona and Brofoyedru.

Conversely all the samples analysed were below the EU permissible level of 0.50 mg/kg. In a study conducted in 1996 in the UK, eggs analysed as part of the Total Diet Survey were found to contain residues of DDT (WPPR, 1996). A similar trend of the residual concentrations of DDT and DDD were observed for the two regions.

In Ashanti region, the concentration of endosulfan I was below the EU and Japanese allowable levels of 0.10 mg/kg except cocoa beans from Ampenin and Brofoyedru. There were non-detectable levels of endosulfan I in cocoa beans from Juaso and Apagya. For endosulfan II, all the samples were below the EU, Japanese and Codex MRL value of 0.10 mg/kg except cocoa beans from Ampenim. Generally the concentration of endosulfan I was higher than endosulfan II. A similar trend was observed in both regions and the levels of endosulfan II in the Brong Ahafo region were higher than samples from the Ashanti region.

## 5. CONCLUSION

From this study it can be concluded that most of the pesticides residues analysed in the Brong Ahafo and Ashanti regions were below the EU and Japanese pesticide residue permissible levels for cocoa beans.

Among the pesticides detected it was found that DDT recorded the highest residual concentrations for samples from in the Brong Ahafo region. The lowest pesticide residual concentration was recorded for Endosulfan I for Sankore in the Ashanti region.

**Acknowledgement**

## References

Amoah, P., Drechel, P., Abaidoo, R. C. and Ntow, W. J. (2006). Pesticide and pathogen contamination of vegetables in Ghana's urban markets. Archives of Environmental Contamination and Toxicology. 50: 1–6.

Anon, (Anonymous). (1995). Report on causes of recent decline in cocoa production in Ghana and measures to revamp the industry. Report submitted to office of President, Accra. 9: 103

Biziuk, M., Przyjazny, A., Czerwinski, J. and Wiergowski, M. (1996). Trace determination of pesticides in water. Journal of Chromatography. A 754: 102

Darko, G. and Acquaah, S. (2007). Levels of organochlorine pesticides residues in meat. International Journal of Environmental Science and Technology 4 (4): 521–524.

Darko, G. and Acquaah, S. O. (2008). Levels of organochlorine pesticide residues in dairy products in Kumasi, Ghana. Chemosphere 71 (2), 294–298

El-Nahhal, Y. (2004). Contamination and safety status of plant food in Arab countries. Journal of Applied Science 4: 411-417.

EPA, (Environmental Protection Agency-Ghana), (2008). Register of pesticides as at 31st December 2008 under Part 11 of the environmental protection agency act, 1994 (Act 490). www.epa.gov.gh/ghanalex/acts/Acts/enviromental%20protect. Accessed on 22nd June, 2010

European Communities (2005). The European Union On-line. Official Documents. Available at http://europa.eu.int. Accessed on 22nd June 2010.

FAO/WHO on pesticides (1978). Acceptable daily intakes, residue limits and guideline levels. *http://fao.org/codex/meetings/CCCF/cccf5/cf05_INF.pdf* Accessed on 20th June 2010

FAO/WHO on pesticides (1986). Acceptable daily intakes, residue limits and guideline levels. ht*tp://fao.org/codex/meetings/ccpr/ccpr32/pr00_05e.pdf* Accessed on 10th 2011

FAO/UNEP/WHO (1991). GEMS: Food Contamination Monitoring Program, Summary of 1986–1988 Monitoring Data. WHO, Geneva, Switzerland Available at http www.codexalimentarius.org/input/download/report/18/al93_12e.pdf. Accessed on 12th May, 2010.

FDA (Food and Drug Administration of United States) (2005). Pesticide Program Residues Monitoring 2003. FDA Pesticide Program. Residue Monitoring Available at http://vm.cfsan.fda.gov/~dms/pes

rpts.html, Accessed on 12th May, 2010.

Frimpong,S., Yeboah P., Fletcher, ,J.J, Adomako, D., Osei-Fosuc, P., Acheampong. K., Gbeddy, G., Doyi, I., Egbi, C., Dampare, S. and Pwamang, J. (2012). Organochlorine pesticides levels in fermented dried cocoa beans produced in Ghana. Elixir Agriculture 44, 7280-7284.

Ghana web (2013). COCOBOD moves to increase cocoa price. Dailyguideghana.com. Accessed on 10TH May, 2013.

Hanson, R., Dodoo, D. K. and Essumang, D. K. (2007). The effect of some selected pesticides on the growth and reproduction of fresh water oreochromis niloticus, chrysicthys nigrodigitatus and clarias griepings. Bulletin of Environmental Contamination and Toxicology 79: 544-547.

Hayes, W. J. and Laws E. R. (1990), Classes of Pesticides. Handbook of Pesticide Toxicology, Academic Press, Incorporation, 3:15– 23

Hussain, S., Masud, T. and Ahad, K. (2002). Determination of pesticides residues in selected varieties of mango. Pakistan Journal of Nutrition 1: 41-42.

ICCO, (International Cocoa Organisation) (2006). Annual report. http://www.icco.org. Accessed on 25th June, 2010

ICCO (International Cocoa Organisation) (2008).The farmer's voice, EU limits pesticides on cocoa. .

http://www.icco.org. Accessed on 10th November 2010.

Kannan, K., Tanabe, S., Williams, R. J., and Tatsukawa, R. (1994). Persistant organochlorine residues in foodstuffs from Australia, Papua New Guinea and the Solomon Islands: contamination levels and human dietary exposure. Science of the Total Environment, 153: 29-49.

Ntow, W. J. (2001): Organochlorine pesticides in water, sediment, crops, and human fluids in a farming community in Ghana. Archives of Environmental. Contamination and Toxicology. 40: 557–563.

Osafo, S. and Frimpong, E. (1998): Lindane and endosulfan residues in water and fish in the Ashanti region of Ghana. Journal of Ghana Science Association. 1: 135–140

Osei, T. K. (2008). Cost-Benefit Analysis in Maintaining Quality of Ghana's Cocoa Beans. Dspace at KNUST. A thesis submitted to the Department of Accounting and Finance. pp 57. Accessed on 12th January 2011.

Parimi, S., Meinke, L. J., French, B. W., Chandler, L. D. and Siegfried, B. D. (2006). Stability and persistence of aldrin and methyl-parathion resistance in western corn rootworm populations (coleoptera: chrysomelidae). Crop Protection, 25: 269-274.

Quality Control Division (Cocobod) Accra, Ghana. (1994). Proceedures for grading and sealing of cocoa and other produce. 1989 edition. Accessed on 13th October 2011.

Ritter, L., Solomon, K. R., Forget, J., Stemeroff, M. and Leary, C. O. (1995). An Assessment Report on Persistent Organic Pollutants. Canadian Network of Toxicology Centres 83: 196-213

Syoku-An. (2006) Method as specified by Multi-Residue Method for Agricultural Chemicals by GC/MS as released by the Department of Food Safety, Ministry of Health, Labour and Welfare, Japan. *Available at http.www.qsenjr.com*. Accessed on 20th May, 2011.

WPPR, (Working Party on Pesticides Residues) (1996), Annual Report. Ministry of Agriculture, Fisheries and Food and Health and Safety Executive, MAFF publications, 97: 260–261

# Levels of Organochlorine Pesticide Residues in Cocoa Beans from Ashanti and Brong Ahafo Regions of Ghana

**Boakye Sandra*[1], Jonfia-Essien William[2], Voegborlo Bright Ray[3], Owusu Boadi Nathaniel[3]**

[1]Radford University College. Department of Applied Science, Accra Ghana;
[2]Quality Control Company Ltd, (COCOBOD). Accra;
[3]Kwame Nkrumah University of Science and Technology.  Department of Chemistry.
Kumasi, Ghana
*Email: sanance1@yahoo.com

## Abstract

The monitoring of pesticide residues in food has become a priority objective worldwide in order to get an extensive evaluation of food quality and to avoid harm to human health. This study presents results of analysis conducted on four pesticide residues in cocoa beans sampled from the Brong Ahafo and Ashanti Regions of Ghana. The pesticides were extracted from cocoa beans using liquid- liquid extraction followed by clean up with solid-phase extraction cartridges. Final extracts were dissolved in ethyl acetate and analysis carried out by Gas Chromatography with Electron Capture Detector. Pesticides were identified by their retention times and quantification using an external calibration method. From the results it could be deduced that 92.5 % of the pesticides residues detected in both regions were below the EU and Japanese allowable limits. Endosulfan I had high residual concentrations for cocoa beans found in Berekum, Hwidiem, Brofoyedru and Ampenim samples. Endosulfan II exceeded permissible levels for Goaso and Ampenim samples. However DDT and DDD were found to be below Maximum Residue Limits established by EU and Japanese organizations in all samples.

## 1. INTRODUCTION

The main cash crop in Ghana is cocoa and the country currently has annual production of around 850,000 metric tonnes (ghanaweb.com, 2013). Cocoa represents around 30% of Ghana's total export earnings and it is the second most important export commodity after gold (ICCO, 2006). Cocoa serves as the major source of revenue for the provision of socio-economic infrastructure in the country (Anon, 1995). In terms of quality, Ghana is recognized as the world leader in premium quality cocoa beans production and the quality of Ghana's cocoa has been a benchmark for assessing cocoa from other countries (Osei, 2008).

Cocoa is affected by a range of pests and diseases, with some estimates putting losses as high as 30% to 40% of global production (ICCO, 2008). Pests and disease problems which are of concern in cocoa production in Ghana include the cocoa swollen shoot virus, capsids, insect pests of the cocoa tree (termites and stem borers), weeds and insect pests of storage such as beetles and warehouse moths (ICCO, 2008). To minimize the economic losses caused by these pests and diseases in the cocoa industry; various pesticides and herbicides are used on cocoa on a massive scale (Hayes and Laws, 1991). In Ghana, the majority of pesticides used in agriculture are employed in the forest zones located in the Ashanti, Brong Ahafo, Western and Eastern Regions of the country (Amoah et al., 2006).

Organochlorine pesticides (OCPs) are very stable solids with limited vapour pressure and very low water solubility. The hazardous nature of organochlorines is a result of their toxicity in combination with high chemical and biological stability and a high degree of lipophilicity (Biziuk et al, 1996). These aforementioned characteristics make the Organochlorine pesticides prone to bioaccumulation along the food chain involving a wide range of trophic levels. Research data available have indicated the presence of pesticide residues in dairy products, meat (Darko and Acquaah, 2007, 2008) fish, water, sediments (Darko and Acquaah, 2008), human blood and breast milk (Ntow, 2001), fruits and vegetables (Hanson et al., 2007; Hussain et al., 2002; El-Nahhal, 2004). It has been reported that, in 1978, data submitted to the Food and Agricultural Organization / World Health Organization (FAO/WHO) indicated that the levels of lindane in cocoa beans from Ghana were between 0.0 and 0.3 mg kg$^{-1}$ and between 0.051-0.10 mg kg$^{-1}$ in cocoa butter. The residue in cocoa mass was 0.038 mg kg$^{-1}$ which was below the established FAO/WHO maximum residue limit of 1.0 mg kg-1 (FAO/ WHO, 1978).

Recently, there have been some complaints about high levels of chemical residues in cocoa beans. Standards and regulations for the export markets have increased over the last decade dramatically in number and stringency in response to food, health and environmental safety leading to the establishment of maximum residue limits (MRLs). MRLs

encourage food safety by restricting the concentration of a residue permitted on a commodity, and by limiting the type of commodity in which it is allowed (European Communities, 2005; FAO/UNEP/WHO, 1991; FDA, 2005). Monitoring programs have therefore been established to control pesticide residues in food of plant origin in order to ensure compliance with national and international laws, and to reassure consumers that food crops are safe and healthy. Since Ghana is one of the leading cocoa exporters worldwide, it is therefore necessary to monitor the levels of pesticide residues in cocoa beans to determine whether the quality of cocoa beans produced in Ghana conforms to international standards.

## 2. METHODOLOGY

### 2.1 Sampling

Dry cocoa beans were sampled from Produce Buying Company warehouse in January 2010 where cocoa beans from different districts of the Ashanti and Brong Ahafo Regions of Ghana were received. At the moment, the high cocoa producing areas are Western, Ashanti and Brong Ahafo regions with the western region leading production figures. However western region was not selected due to bad roads and unfamiliar terrain hence Ashanti and Brong Ahafo regions been the next highest were selected.

The consignment was divided into smaller lots and the split wire was applied as widely as possible to detect foreign matter. A sampling horn was used to draw samples from top, bottom and sides of each cocoa bag and bulked into a container. The bulked sample was thoroughly mixed and quartered. Two quarters of the opposite sides were rejected. The process was repeated until a final sample of 300 beans was counted into bags. One of the bags containing the 300 beans was sent to the laboratory for analysis (Quality Control Division, 1994).

### 2.2 Reagents and apparatus

Acetonitrile, acetone, ethyl acetate and toluene were pesticide grade (BDH, England). Acetone, dipotassium hydrogen phosphate and potassium dihydrogenphosphate were analyt grade (BDH, England). Sodium sulfate was pesticide grade (Aldrich- Chemie, Germany), sodium chloride (Pesticide grade, Riedel-de Haen), Envi-carb/LC-NH$_2$ (500 mg/500 mg/ 6 mL) from Supelco C-18 (USA).

### 2.3 Experimental Procedures

Before analysing the samples all glass wares were acid washed and cleansed with distilled water and dried in the oven at 200 $^o$C for about four hours.

### 2.4 Analysis for pesticides

Sample preparation, extraction, clean-up and analysis were carried out according to the procedure described in multi-residue method for agricultural chemicals (Syoku-An, 2006).

### 2.4.1 Sample extraction

The extraction procedure describe below was adapted from Japanese analytical method for multi-residues for agricultural chemicals (Syoku-An, 2006). 10 g of cocoa beans were thoroughly ground and about 20 ml of distilled water was added. It was stirred to form a homogeneous mixture and allowed to stand for

15 minutes. An amount of 50 ml acetonitrile was added and macerated for 2 minutes. It was centrifuged (Sanyo (MSE) Harrier 18 / 80, Japan) at a speed of 3000 rpm for 3 minutes and filtered through Whatman No. 4 filter paper into 100 ml volumetric flasks. An amount of 20 ml acetonitrile was added to the residue and homogenization process repeated for 2 minutes. The jar was rinsed with 15 ml acetonitrile and residue, filtered and all filtrates adjusted to the 100 ml mark with acetonitrile. An aliquot of 20 ml was pipetted into a 250 ml separating funnel. 10g of NaCl and 20 ml of 0.5 mol/L phosphate buffer (pH 7.0) were added. The separating funnel was corked and shaken for 20 minutes using the electronic shaker (BS-GS-10 CN-ZHE, China) and allowed to stand for another 10 minutes. The organic layer was transferred into 50 ml beaker for further clean-up.

## 2.4.2 First Clean-up using Bond Elute C-18 cartridges

Bond Elute C-18 (1000 mg/6 ml) cartridge was conditioned with 10 ml acetonitrile. A receiving flask was placed under the cartridge to collect elute. Approximately 20 ml of the sample extract was loaded into the cartridge and eluted with 2 ml acetonitrile. An amount of 5 g $Na_2SO_4$ was placed on a filter paper in a funnel and the extract dried over it. The container was rinsed with acetonitrile and passed through the $Na_2SO_4$. The sample solution was transferred into 50 ml round bottom flask and evaporated at 40 °C to dryness on a rotary evaporator (Bucchi India). Residue was dissolved in 2 ml of 1:3 (Toluene: Acetonitrile)

## 2.4.3 Second clean – up using ENVI -Carb/LC – NH₂

ENVI – Carb/LC – NH₂, (500 mg/500 mg)/6 ml cartridge was conditioned with 10 ml of 1:3 toluene: acetonitrile. The 2 ml extract from the previous clean – up step was loaded into the cartridge and eluted. The cartridge was eluted with 20 ml of 1:3 (toluene: acetonitrile). The sample solution was transferred into a 50 ml round bottom flask and evaporated at 40 °C to approximately 1 ml by rotary evaporator. An amount 10 ml of acetone was added to the flask and was concentrated just to dryness.

The extracts were re-dissolved in 2 ml ethyl acetate in vials and 0.5 ml used for injection. Quantification was achieved by gas chromatography analysis using electron capture detector (Shimadzu GC - 2010, Japan).

## 2.4.4 Quantification of Pesticide Residues

The residue levels of organochlorine pesticides were quantitatively determined by the external standard method (Chung et al, 2010) using peak areas. The peak areas whose retention times coincided with the standards were extrapolated on their corresponding calibration curves to obtain the concentration. Details of chromatographic conditions are shown in Table 1.

**Table1.** Summary of chromatographic conditions for pesticides analyses

(a) **Description of instrument**

| Instrument | Description |
|---|---|
| Gas Chromatograph | Shimadzu GC – 2010 with AOC 20 I Autoinjector and AOC 20 S Auto sampler and Electron Capture Detector |
| Analytical column | 30 m x 0.25 mm internal diameter fused silica capillary column coated with VF-5 ms (0.25 μm film). |

**(b) Temperatures**

| Item | Conditions |
|---|---|
| Injector | Splitless mode, temperature 225 ° C |
| Oven | 60 °C / 2 min 25 °C/1min 180 °C / 1min 5 °C /1 min 300 °C |
| Detector – ECD | 300 °C |

**NOTE:** Nitrogen was used as the carrier gas and was maintained at a flow rate of 1 ml/min

### 2.4.5 Quality control and quality assurance

Quality of pesticides was assured through the analysis of solvent blanks, matrix blanks and duplicate samples. All reagents used during the analysis were exposed to same extraction procedures and subsequently run to check for interfering substances. In the blank for each extraction procedure, no pesticide was detected. Sample of each series was analyzed in duplicates. The method was optimized and validated by fortifying the ground and homogenized cocoa beans sample with 500 μL of 1.0 μg/mL pesticide standards mixture before analysis to evaluate the recovery of compounds. The recoveries of internal standards ranged between 67 % and 130 % for most of the pesticides analyzed.

### 2.4.6 Data Analysis

Concentration of OCPs in cocoa bean samples injected was recorded in ug/ml. To obtain the concentration of OCPs in mg/kg, the formula below was used.

$$\left\{\left[\frac{C}{F}\right] \times 5\right\}/M$$

Where C=concentration in ug/ml

F= Concentration Factor (10)

M = mass in grams

### 2.4.4 Recovery

An aliquot of Standard mixture 1 (MIX 1) which comprised of mixture of pesticides standards was added to 20 g of an aliquot of a prepared matrix (1ml = 20 μg of each analyte). This is equivalent to a fortification level of 1 mg/kg. Extraction and clean – up procedure as in the methodology were carried out before its injection into the GC. Same chromatographic conditions were used. This was repeated for fortification levels of 0.5 mg/kg and 0.2 mg/kg.

The percentage recovery was calculated as:

$$\% \text{ Recovery} = \frac{\text{Amount of analyte recovered}}{\text{Amount of analyte spiked}} \times 100$$

### 3. RESULTS

Pesticide residues identified in the cocoa beans were DDT, DDD, endosulfan I and II. Each pesticide corresponded to that obtained from

the standard mix chromatogram (Fig. 1 and Fig. 2). Fig. 3 is a profile of a cocoa sampled from Offinso in the Ashanti region. The retention times of individual pesticides obtained from the chromatogram are shown in Table 2.



**Figure1.** Chromatogram for pesticide standard mix for DDT and DDD



**Figure 2**. Chromatogram for pesticide standard mix for endosulfan

Figure 3: Chromatogram for cocoa beans from Offinso in Ashanti region

**Table 2.** Retention times of Organochlorine Pesticide standards

| Standards | Retention Time (Min) |
|---|---|
| Endosulfan I | 19.621 |
| Endosulfan II | 21.535 |
| DDD | 21.990 |
| DDT | 23.348 |

Dichlorodiphenyltrichloroethane (DDT) and its metabolites were detected in 100 % of the analysed samples. For DDT, the lowest concentration was 0.08 mg/kg and was recorded for cocoa beans from Sunyani and Nyinase A and the highest concentration was 0.46 mg/kg which was recorded for cocoa beans from Asumura. The mean concentration for DDT was 0.28 mg/kg (Table 3).

Levels of dichlorodiphenyldichloroethane (DDD) present in cocoa beans in Brong Ahafo region ranged from 0.03 mg/kg for cocoa beans from Sankore, Sunyani, Asumura, Goaso, Mim, Nyinase and Nkrankwanta to 0.06 mg/kg for samples from Nyinase A. The mean concentration of DDD was 0.03 mg/kg (Table 3)

Endosulfan I and II were present in all the cocoa beans sampled from the different locations in the Brong Ahafo region. Concentrations of the endosulfan II residues in cocoa beans in all the sampling areas were lower than endosulfan I.

**Table 3**. Pesticide residues in cocoa beans from Brong Ahafo region

| Name of Pesticide | Mean Concentration (mg/kg) | SD | MRL EU | MRL JAPAN | Source of samples exceeding MRLS |
|---|---|---|---|---|---|
| Endosulfan I | 0.07 | 0.03 | 0.10 | 0.10 | Brekum, Hwidiem |
| Endosulfan II | 0.07 | 0.03 | 0.10 | 0.10 | Goaso |
| DDT | 0.28 | 0.30 | 0.50 | 0.05 | None |
| DDD | 0.03 | 0.01 | 0.50 | 0.05 | None |

**NOTE:** Goaso 0.11 mg/kg, Berekum and Hwidiem 0.20 mg/kg

Levels of endosulfan I ranged from 0.01 mg/kg for samples from Sankore to 0.20 mg/kg for cocoa beans from Berekum and Hwediem. The mean concentration was 0.07 mg/kg (Table 3). All the cocoa beans sampled from most of the locations in the Brong Ahafo region had concentrations lower than EU and Japan MRL values of 0.10 mg/kg with the exception of samples from Berekum and Hwediem. Levels of endosulfan II detected in the cocoa beans from the Brong Ahafo region were between

0.04 mg/kg for samples from Sankore to 0.11 mg/kg for samples from Goaso. The mean concentration for endosulfan II was 0.07 mg/kg (Table 3).

**Table 4:** Pesticide residues in cocoa beans from Ashanti region

| Name of Pesticide | Mean Concentration (mg/kg) | SD | EU | MRL JAPAN | Source of samples exceeding MRLS |
|---|---|---|---|---|---|
| Endosulfan I | 0.07 | 0.06 | 0.10 | 0.10 | Ampenim, Brofoyedru |
| Endosulfan II | 0.08 | 0.03 | 0.10 | 0.10 | Ampenim |
| DDT | 0.13 | 0.09 | 0.50 | 0.05 | None for EU |
| DDD | 0.03 | 0.02 | 0.50 | 0.05 | None For EU |

**NOTE:** Ampenim 0.16 mg/kg for endosulfan II

**Table 5:** Concentration of pesticide residues in sampling areas of Brong Ahafo region

| Pesticide | SAN | ASU | KUK | SUY | NYI | GOA | BRE | NKR | HWI | MIM | EU | JAP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DDT | 0.15 | 0.46 | 0.24 | 0.08 | 0.08 | 0.17 | 0.11 | 0.19 | 0.20 | 0.22 | 0.50 | 0.10 |
| DDD | 0.03 | 0.03 | 0.04 | 0.03 | 0.06 | 0.03 | 0.04 | 0.03 | 0.02 | 0.03 | 0.50 | - |
| Endosulfan I | 0.01 | 0.05 | 0.04 | 0.04 | 0.04 | 0.04 | 0.20 | 0.06 | 0.20 | 0.06 | 0.10 | 0.10 |
| Endosulfan II | 0.04 | 0.09 | 0.08 | 0.08 | 0.07 | 0.11 | 0.07 | 0.08 | 0.09 | 0.09 | 0.10 | 0.10 |

**NOTE** : SAN –Sankore, ASU – Asumura, KUK – Kukuom, SUY – Suyani, NYI – Nyinase A , GOA – Goaso, BRE –Brekum, NKR – Nkrankwanta, HWI– Hwidiem.

In the Ashanti region, DDD residues were not detected in cocoa beans sampled from Ampenim, Nyinahini and Juaso. The highest concentration was 0.05 mg/kg for samples from Brofoyedru and the lowest concentration was 0.02 mg/kg for samples from Nkawie. The mean concentration for DDD residues was 0.03 mg/kg (Table 4). All the samples were within the EU and Japanese MRL value of 0.50 mg/kg and 0.05 mg/kg respectively. In the Ashanti region, DDT residues ranged from 0.02 ppm for samples from Brofoyedru to 0.20 mg/kg for samples from Ampenim and New Edubiase.

The mean concentration was 0.13 mg/kg (Table 4).

In the Ashanti region, the levels of endosulfan I in cocoa beans ranged from 0.04 mg/kg for samples from Nkawie and Agona to 0.20 mg/kg for samples from Brofoyedru. The mean concentration for endosulfan I was 0.07 mg/kg (Table 4). There were non-detectable levels of endosulfan I in cocoa beans from Juaso and Apagya. Endosulfan II in cocoa beans ranged from 0.05 mg/kg for samples from New Edubiase to 0.16 mg/kg for samples from Ampenim. The mean concentration was 0.08 mg/kg (Table 4).

**Table 6:** Concentration of pesticide residues in sampling areas of Ashanti region

| Pesticide | AMP | NYI | MAN | JUA | NEW | NKA | AGO | OFF | BRO | APA | EU | JAP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DDT | 0.20 | 0.17 | 0.0 | 0.10 | 0.20 | 0.09 | 0.04 | 0.08 | 0.02 | 0.07 | - | 0.50 |
| DDD | 0.01 | 0.01 | 0.03 | 0.01 | 0.03 | 0.02 | 0.04 | 0.04 | 0.05 | 0.03 | - | 0.50 |
| Endosulfan I | 0.12 | 0.05 | 0.05 | 0.01 | 0.06 | 0.04 | 0.04 | 0.10 | 0.20 | 0.01 | 0.10 | 0.10 |
| Endosulfan II | 0.16 | 0.09 | 0.07 | 0.07 | 0.05 | 0.08 | 0.06 | 0.07 | 0.08 | 0.07 | 0.16 | 0.10 |

**NOTE:** NYI – Nyinahini, MAN– Mankranso, JUA – Juaso, NEW – New Edubiase. NKA – Nkawie, OFF – Offinso, BRO – Brofoyedru, APA – Apagya, AGO – Agona AMP– Ampenim

## 4. DISCUSSION

In the present study, there were presence of both DDT and its metabolite DDD in the samples though they have been banned in Ghana since 1985 (EPA Ghana, 2008). This

could be attributed to the persistence and long range transport nature of DDT and its metabolite DDD (Ritter et al., 1995, Kanan et al, 1994, Parimi et al, 2006). The concentrations of DDT residues in all the cocoa beans from sampling areas in Brong Ahafo region were

higher than DDD (Fig. 3). It could be inferred from the trend that there is a continuous use of DDT in the area due to its lower cost and effectiveness as well as its broad spectrum activity despite its ban (Amoah et al., 2006)



**Figure 4:** Mean concentration of pesticide residue in mg/kg in Brong Ahafo and Ashanti regions

Although the food samples were contaminated with DDT and DDD, the maximum residue levels were below FAO's MRL and the standards set by some European countries. The concentrations of DDT found in this survey were lower than those recorded for fresh milk from some developing countries such as, Uganda 3.24 mg/kg, Nigeria 3.83 mg/kg, India 6.55 mg/kg, Kenya 6.99 mg/kg, South Africa

20.10 mg /kg and Ethiopia 7.75 mg /kg (FAO, 1986).

For endosulfan I, all the cocoa beans sampled from most of the locations in the Brong Ahafo region had concentrations lower than EU and Japan MRL values of 0.10 mg/kg with the exception of samples from Berekum and Hwediem. A research conducted by Frimpong et al, (2012) revealed that the mean endosulfan I residue concentration in cocoa beans from Tema warehouse to be 16.7 ± 6.8 μg/kg which was lower than the results obtained in this study. Endosulfan I residues have also been recorded in crops and in fish in Ghana (Ntow, 2001; Osafo and Frimpong, 1998). An appreciable concentration of an endosulfan I

was measured in the breast milk samples of human beings (Ntow, 2001). However endosulfan I is considered for restrictive use in Ghana (EPA, 2008).

All samples analysed for endosulfan II for Brong Ahafo region were within the EU and Japanese MRL values of 0.10 mg/kg with the exception of samples from Goaso which had concentration of 0.11 mg/kg, which is slightly above the set limit. A study by Frimpong et al, 2012, on endosulfan II residues in cocoa beans indicated mean concentration of $9.4 \pm 4.8$ µg/kg which was lower than the results obtained in this research.

Out of the number of samples analysed for DDT residues in the Ashanti region, 80 % were above the Japanese MRL of 0.05 mg/kg except cocoa beans from Agona and Brofoyedru. Conversely all the samples analysed were below the EU permissible level of 0.50 mg/kg. In a study conducted in 1996 in the UK, eggs analysed as part of the Total Diet Survey were found to contain residues of DDT (WPPR, 1996). A similar trend of the residual concentrations of DDT and DDD were observed for the two regions.

In Ashanti region, the concentration of endosulfan I was below the EU and Japanese allowable levels of 0.10 mg/kg except cocoa beans from Ampenin and Brofoyedru. There were non-detectable levels of endosulfan I in cocoa beans from Juaso and Apagya. For endosulfan II, all the samples were below the EU, Japanese and Codex MRL value of 0.10 mg/kg except cocoa beans from Ampenim. Generally the concentration of endosulfan I was higher than endosulfan II. A similar trend

was observed in both regions and the levels of endosulfan II in the Brong Ahafo region were higher than samples from the Ashanti region.

## 5. CONCLUSION

From this study it can be concluded that most of the pesticides residues analysed in the Brong Ahafo and Ashanti regions were below the EU and Japanese pesticide residue permissible levels for cocoa beans.

Among the pesticides detected it was found that DDT recorded the highest residual concentrations for samples from in the Brong Ahafo region. The lowest pesticide residual concentration was recorded for Endosulfan I for Sankore in the Ashanti region.

### References

Amoah, P., Drechel, P., Abaidoo, R. C. and Ntow, W. J. (2006). Pesticide and pathogen contamination of vegetables in Ghana's urban markets. Archives of Environmental Contamination and Toxicology. 50: 1–6.

Anon, (Anonymous). (1995). Report on causes of recent decline in cocoa production in Ghana and measures to revamp the

industry. Report submitted to office of President, Accra. 9: 103

Biziuk, M., Przyjazny, A., Czerwinski, J. and Wiergowski, M. (1996). Trace determination of pesticides in water. Journal of Chromatography. A 754: 102

Darko, G. and Acquaah, S. (2007). Levels of organochlorine pesticides residues in meat. International Journal of Environmental Science and Technology 4 (4): 521–524.

Darko, G. and Acquaah, S. O. (2008). Levels of organochlorine pesticide residues in dairy products in Kumasi, Ghana. Chemosphere 71 (2), 294–298

El-Nahhal, Y. (2004). Contamination and safety status of plant food in Arab countries. Journal of Applied Science 4: 411-417.

EPA, (Environmental Protection Agency-Ghana), (2008). Register of pesticides as at 31st December 2008 under Part 11 of the environmental protection agency act, 1994 (Act 490). www.epa.gov.gh/ghanalex/acts/Acts/enviromental%20protect. Accessed on 22nd June, 2010

European Communities (2005). The European Union On-line. Official Documents. Available at http://europa.eu.int. Accessed on 22nd June 2010.

FAO/WHO on pesticides (1978). Acceptable daily intakes, residue limits and guideline levels. *http://fao.org/codex/meetings/CCCF/cccf5/cf05_INF.pdf* Accessed on 20th  June 2010

FAO/WHO on pesticides (1986). Acceptable daily intakes, residue limits and guideline levels. ht*tp://fao.org/codex/meetings/ccpr/ccpr32/pr00_05e.pdf* Accessed on 10th 2011

FAO/UNEP/WHO (1991). GEMS: Food Contamination Monitoring Program, Summary of 1986–1988 Monitoring Data. WHO, Geneva, Switzerland Available at httpwww.codexalimentarius.org/input/download/report/18/al93_12e.pdf. Accessed on 12th May, 2010.

FDA (Food and Drug Administration of United States) (2005). Pesticide Program Residues Monitoring 2003. FDA Pesticide Program. Residue Monitoring Available at http://vm.cfsan.fda.gov/~dms/pesrpts.html, Accessed on 12th May, 2010.

Frimpong,S., Yeboah P., Fletcher, ,J.J, Adomako, D., Osei-Fosuc, P., Acheampong. K., Gbeddy, G.,  Doyi, I., Egbi, C., Dampare, S. and Pwamang, J. (2012). Organochlorine pesticides levels in fermented dried cocoa beans produced in Ghana. Elixir Agriculture 44, 7280-7284.

Ghana web (2013). COCOBOD moves to increase cocoa price. Dailyguideghana.com. Accessed on 10TH May, 2013.

Hanson, R., Dodoo, D. K. and Essumang, D. K. (2007). The effect of some selected pesticides on the growth and reproduction of fresh water oreochromis niloticus, chrysicthys nigrodigitatus and clarias griepings. Bulletin of

Environmental Contamination and Toxicology 79: 544-547.

Hayes, W. J. and Laws E. R. (1990), Classes of Pesticides. Handbook of Pesticide Toxicology, Academic Press, Incorporation, 3:15– 23

Hussain, S., Masud, T. and Ahad, K. (2002). Determination of pesticides residues in selected varieties of mango. Pakistan Journal of Nutrition 1: 41-42.

ICCO, (International Cocoa Organisation) (2006). Annual report. http://www.icco.org. Accessed on 25th June, 2010

ICCO (International Cocoa Organisation) (2008).The farmer's voice, EU limits pesticides on cocoa. . http://www.icco.org. Accessed on 10th November 2010.

Kannan, K., Tanabe, S., Williams, R. J., and Tatsukawa, R. (1994). Persistant organochlorine residues in foodstuffs from Australia, Papua New Guinea and the Solomon Islands: contamination levels and human dietary exposure. Science of the Total Environment, 153: 29-49.

Ntow, W. J. (2001): Organochlorine pesticides in water, sediment, crops, and human fluids in a farming community in Ghana. Archives of Environmental. Contamination and Toxicology. 40: 557–563.

Osafo, S. and Frimpong, E. (1998): Lindane and endosulfan residues in water and fish in the Ashanti region of Ghana.

Journal of Ghana Science Association. 1: 135–140

Osei, T. K. (2008). Cost-Benefit Analysis in Maintaining Quality of Ghana's Cocoa Beans. Dspace at KNUST. A thesis submitted to the Department of Accounting and Finance. pp 57. Accessed on 12th January 2011.

Parimi, S., Meinke, L. J., French, B. W., Chandler, L. D. and Siegfried, B. D. (2006). Stability and persistence of aldrin and methyl-parathion resistance in western corn rootworm populations (coleoptera: chrysomelidae). Crop Protection, 25: 269-274.

Quality Control Division (Cocobod) Accra, Ghana. (1994). Proceedures for grading and sealing of cocoa and other produce. 1989 edition. Accessed on 13th October 2011.

Ritter, L., Solomon, K. R., Forget, J., Stemeroff, M. and Leary, C. O. (1995). An Assessment Report on Persistent Organic Pollutants. Canadian Network of Toxicology Centres 83: 196-213

Syoku-An. (2006) Method as specified by Multi-Residue Method for Agricultural Chemicals by GC/MS as released by the Department of Food Safety, Ministry of Health, Labour and Welfare, Japan. *Available at http.www.qsenjr.com*. Accessed on 20th May, 2011.

WPPR, (Working Party on Pesticides Residues) (1996), Annual Report. Ministry of

Agriculture, Fisheries and Food and

Health and Safety Executive, MAFF

publications, 97: 260–261

# The Impact of Foreign Aid on Gdp and Inflation in Ghana

**[1] Samuel Antwi, & [2] Eugene Oware Koranteng**
Accountancy Department, Koforidua Polytechnic, Koforidua,
samyantwi@yahoo.com

## Abstract

Foreign aid has become one of the most important sources of capital flows to developing countries in the present past. According to development theorists, this massive inflow of capital wilt fill the foreign exchange gap and propel developing countries into sustained growth and development. This study attempts to examine the impact of this massive capital inflow on the inflation and the growth of output in Ghana for the period under consideration. The principal objective of the study is to examine the impact of foreign aid on the real gross domestic product of Ghana. Specifically the study examines the relationship between foreign aid and output growth and also foreign aid and inflation. The analysis is guided by the hypothesis that foreign aid enhances output and raises the level of inflation. Based on the results of the analysis, we accept the hypothesis that foreign aid enhances output. We also accept

the hypothesis that aid is deflationary. The policy implication is that Ghana should invest aid monies in areas that yield greater and faster returns, in direct productive activities. The country should also take more concessionary loans to reduce the overall debt burden of the country.

**INTRODUCTION**

Foreign aid plays a very important role in the development process of many countries. Countries unable to generate sufficient domestic savings to pursue economic growth policies have historically sought finance from other countries. The United States of America relied heavily on foreign savings, particularly during the antebellum period from 1835 to 1860. Russia also needed foreign savings for its development in the three decades before World War I and the communist revolution. Developing countries have in most cases after the attainment of independence depended on aid flows. Countries like Tanzania and Zambia have had a notorious and rocky aid relationship, experiencing aid booms that mirror their policy stances. Both countries

received increasing amounts of aid in the late 1970s, which decreased abruptly in the 19805 after the introduction of the policy based lending by the IME and other aid institutions. Foreign aid thus plays a very significant role in the development process (Gillis and Perking 1992). The world over, a lot of countries have and continue to rely on foreign aid to help in its development process. Ghana achieved independence in 1957 and experienced a relatively stable growth and prosperity due to the large foreign reserves at the time of independence. Domestic savings then were

very high. Ewusi (1973) observed that foreign capital played a rather insignificant role in the growth of the economy during the colonial period. This could mean that savings that enabled the economy to grow in the colonial period were generated locally. However a few years after independence, the gross domestic savings in Ghana started dwindling and so the need arose for the economy to depend on foreign capital in the form of aid. In the seven-year development plan of 1963/64-1969170, a prominent role was accorded to foreign capital in financing the plan. Out of the total amount of 1016 million pounds investment, it was estimated that one third of it was expected to come from foreign loans and grants. The role of foreign capital has since assumed a significant role in the economic policy of Ghana due to low domestic saving and worsening terms of trade. At constant prices, domestic savings in Ghana was about 14% of G. D. P. in 1957. In the 1980s however, there were problems as the economy continued to experience a downward trend, in domestic savings while at the same time demand for social infrastructure grew as population increased. Deficit in the current accounts was a common thing. In 1981 for instance, deficit on current account was ¢1,160 million and it rose to ¢2738.8 million in 1984. By 1985, this has risen to about ¢8720.9 million. In the early 1990's this deficit has reached ¢114669.8 million. Gross domestic savings declined as a result of low incomes, public

consumption and investment continued to expand, external resources were needed to finance the growing deficit on the budget. In 1980 total consumption was 40737.7 million cedis and this rose to 252,663 .5 million in 1984 while total investment rose from 2410 million cedis to 18607 million cedis over the same period. According to Teye, Mosley and Harrigan (1991), population growth and improper economic policies plunged the country into hardships; consumption per capita rose while income per capita declined.

Other negative external shocks to the economy compounded the already precarious situation of the country. First there was a fall in the price of cocoa, the country's major export item, secondly serious drought also affected the generation of hydro electronic power and further affected food production leading to near famine. Industrial capacity utilization also fell to 20-25%. For many years Ghana has received average to below average aid flows. A remarkable reversal of economic policies in the early 1980's, beginning with the ERP lunched in 1983, brought a flood of aid in the 1980's and 1990's. From a theoretical perspective, aid is supposed to reduce the foreign exchange gap, supply the much-needed foreign capital for investment and with time put the recipient economy on the path of sustainable growth. Empirical studies have also found aid to be inflationary in some economies and deflationary in others. Empirically not much is known about the impact of this official inflow on macroeconomic aggregates such as GDP and inflationary in Ghana. It is therefore pertinent to examine how foreign aid affects GDP and inflation in Ghana.

The principal objective of the study is to examine the impact of foreign aid on the real gross domestic product of Ghana. Specifically the study will examine the relationship between foreign aid and output growth and also foreign aid and inflation.

## METHODOLOGY
### SPECIFICATION OF THE MODEL

The macro economic impact of aid cannot be appropriately analyzed using a single equation model. Growth of output, investment, savings, inflation and all other macro-economic variables are determined by a host of other factors other than foreign aid alone. Such an influence of exogenous factors on savings for instance has been pointed out in inter-temporal models by various authors Morisset (1989). The macroeconomic model used is adopted from Atta (1981) for the Ghanaian economy.

$$\Delta Y = \Delta Y / \Delta K \Delta Y \left[ \left( F + eY - m_i Y \right) / m_k \right]$$
$$\Delta Y = \Delta Y / \Delta K M_k / m_k$$
$$\left( \Delta Y / Y \right) = k.I \left[ \left( \Delta Y / \Delta K \right) \left( 1 / m_K \right) \right] \left[ \left( F / Y \right) + E - m_i \right]$$
$$s = S / Y$$
$$\partial 0 > 0, \partial_1 > 0, \partial_2 < 0, \partial_3 > 0, \partial_4 < 0$$
$$\Delta X_1 = \beta X_{t-1} + \Sigma_{og} \Delta X_{t-j} + e_t$$

The general structure of the model is described by the following system of equations and the appropriate/expected sign of each variable.

### THE GOODS MARKET

$$S = s \left( Y - T, r, m / p \right) : 0 \angle S_{yd} \angle 1; 0 \angle S_{m/p} \angle 0$$
………………………………(I)

$$I = i(Y - T, r, m/p) : 0 \angle i_{yd} \angle 1; ir \angle 0; 0 \angle i_{m/p} \angle 0$$

…………………………………………...(2)

$$G = g(Y) : 0 \angle g_1 \angle 1 ………………...(3)$$

$$T = t(Y) : 0 \angle t_y \angle 1 ………………...(4)$$

Z = z (Y-T, r, RER): Z; >0; ZRER<O;

Zr<O……………………………………(5)

X = x (RER, $Y^w$, $r^w$): $X_{El}$<0; $X_y{}^w$ >0…..(6)

Y = C+I+G+X-Z………………………(7)

### 4.2.2 THE BALANCE OF PAYMENTS

E = g (NX. F) ………………………… (8)

NX= n (X,Z) …………………………….. (9)

F =q (AID. FDI RER. $R_w$, r, D, FD)…..(10)

### THE MONEY MARKET

$M^d$ = $m^d$ (r, Y. P): m, < 0 ……………....(12)

$M^s$ = $m^s$ (FD, E, P): $m_{FD}$<0; $m_E$ >0 …....(13)

FD = (tY- G) …………….……………(14)

$M^d$ = $M^S$ = M ….………………………(15)

### THE PRODUCTION FUNCTION

Y == f (K., L. T): ……..………………..(16)

Capital consist of domestic and foreign capital

K = k ($K_d$ $K_F$) …..……………………. (17)

$K_F$ = g (FDI AID) ………………………(18)

$K_d$ = h (FD, S) …………..…………..(19)

$L^d$ = f ' (W/p) …………………………. (20)

$L^S$ = f (W/p) ……………………………(21)

$L^S$ = $L^d$ = L = f (W/p) ………………… (22)

Y = f (FDI, AID, FD, S, W. P. T) …... ..(23)

### DEFINITION OF VARIABLES

S     =     Domestic saving

tY     =     Government revenue

G     =     Government Spending

X     =     Export

Z     =     Import

E     =     Foreign Exchange Reserves

$M^d$     =     Nominal Money demand

$M^s$     =     Nominal Money supply

FD     =     Fiscal Deficit which IS the difference between government spending and government revenue.

AID     =     Official Capital Inflows (Total loans and grants disbursed)

RER     =     Real Exchange rate

Y     =     Domestic Income or output

$Y^d$     =     Disposable income

r     =     Nominal Interest Rate

$r^w$     =     Rest of the world Interest Rate proxies by USA interest rates

FDI     =     Foreign direct investment

W     =     wage Rate

$L^d$     =     Demand for Labour

LS     =     Supply of Labour

T     =     Technical Change

K     =     Capital Stock, which can be broken into domestic capital and foreign capital. For the purpose of this study, foreign capital inflows equal official capital inflows (grants and loans).

The first sets of equations define the goods market. Disposable income is defined as total income less tax related to income. Domestic savings (S) is also a function of real disposable income ($Y_d$) real interest rate and real money balances; t is the tax rate. The regularity assumption depict that propensity to save, out of disposable income is between zero and one; the interest elasticity to save is also greater than 0 but less than 1 and the partial derivative of savings with respect to real money balances is

less than zero. Investment (I) is defined as a function of interest (r), disposable income ($Y_d$) and money balance (M) and the general price level. Partial derivative of investment with respect to money balances is between zero and one. The interest elasticity to invest is however less than zero. Government expenditure (G) and government revenue (T) are assumed to depend on income, t is the tax rate. Imports (Z) is also assumed to be a function of disposable income and exchange rate (RER). In the same vein, a proportional tax rate (t) is assumed and so is marginal propensity to import and $Z_{RER}$ is the partial derivative of import with respect to real exchange rate, which is defined as units of local currency per US dollar. Export (X) is defined as a function of real exchange rate (RER) and the expected sign is positive. The last equation in the goods market gives the equilibrium condition where withdrawals (S, T, and Z) are equal to total injections (I, G, X).

The second sets of equations specify the foreign capital inflow function. It assumes that foreign capital inflows depend on the international interest rate (rw), real domestic interest rate (r), and political environment proxies by dummy D. D is zero for military rule (especially in the case of Ghana) and one for democratic rule (civilian). Then we have the variable TOT. It is assumed that the sum of the trade balance and net capital inflows must add up to zero in the balance of payments, $e = X - Z + F = 0$. However in most developing countries this assumption does not hold in most cases and it may either be greater than or less than zero. This has some implication on the supply of money in the economy. If $X - Z + F > 0$, then there is an increase in Central bank reserves which will lead to an increase in money supply. The second equation states the equilibrium in the BOP. F is the net capital inflow, which is capital inflow less domestic capital outflows. In this model it is assumed that domestic capital outflow is almost negligible and so F is identical to foreign direct investment (FDI) and official foreign capital inflows (AID).

The demand for money in this model is defined by a typical Keynesian money demand equation. Where P is the price level, r is the real interest rate, Y is real domestic income and $M^d/p$ is the real demand for money. Introducing the usual assumption that the equation above is homogenous of degree expression for real balances can be derived as $M^d = a_0 + a_1 Y + a_2 r$.

In this equation $a_1$ and $a_2$ are partial derivatives of real money balance with respect to real income and real interest rate respectively. $a_1$ is expected to have a positive sign and $a_2$ negative sign. Money supply in this model is not wholly exogenous. Money supply in this model is assumed to be endogenously determined in the system owing principally to the interdependence of financial and monetary policies and the openness of the Ghanaian economy (Atta 1981). In such an open economy high-powered money (H) issued by the Central Bank is backed by either foreign exchange reserves (E) or fiscal deficit (FD) (Rebmann and Levacic 1982). However domestic money supply tends to move directly with M. thus MS/P is the real money supply function. The last equation gives the equilibrium in money market.

W is exogenously determined and W/p is the domestic real wage rate. From theory the real wage is expected to have a positive relationship with foreign capital inflows. This is because the low wages makes labour cheap in our part of the world. This serves as a pull on foreign capital for investment. From the model output (Y) is also a function of capital, labour, and technology. Capital can be broken into two, domestic and foreign capital. Domestic capital comprises savings and fiscal deficit. Foreign capital consists of FDI and AID.

## STATIONARITY TEST

Time series data are usually non-stationary in their raw state or levels. Running a regression with such data set could produce misleading results (Granger and NewBold, 1974). Dickey-Fuller (DF) and Augmented Dickey-Fuller (ADF) were used to test whether the variables were stationary (I (0)) or needed to be differenced first (I (l)) or second differenced (I (2)) to induce stationarity.

The Dickey-Fuller test is a null hypothesis is a simple unit root (I (1» takes the form:

$$\Delta X_1 = \beta X_{t-1} + \sum_{og} \Delta X_{t-j} + e_t$$

Where $H_o$: I (1) and $H_I$: 1(2)

The test statistics is the standard "t" test on the lagged dependent variable ($\beta$). Because the test is sensitive to whether a drift (C) and/or a time trend (T) are included, it was repeated in different form for each variable.

## RANK AND ORDER CONDITION

Given that there exist G number of equations or endogenous variables and K variables (endogenous and exogenous), and that the i-th equation has M variables, the order condition requires that

(a) If K-M<G-l, then the equation is under identified cannot be estimated.

(b) If K-M>G-l, then the equation is over identified. This equation can be estimated and may have multiple solutions.

(c) If K-M=G-I then the equation is exactly identified and may be estimated with a unique solution. The order condition is a necessary condition but is backed by the rank condition, which is the sufficient condition. The rank condition requires that, given a system of G equations or endogenous variables, the i-th equation is identified if it is possible to construct a one non-zero determinant from the coefficients of the variables excluded from the i-th equation.

## SOURCES OF DATA

Data for the study covers a period of about 23 years that is from 1980 to 2012. Secondary data on macro-economic aggregates has been taken from the ministry of finance and economic planning, Ghana statistical service and the Bank of Ghana. Publications like the 'Quarterly digest of statistics' and the 'International financial statistics' has also been used extensively. The data set includes data on foreign aid, domestic saving, domestic interest rate, international interest rate, investment, GDP, export, government tax revenue, and inflation. For the purpose of this study, foreign aid will be defined as the sum of loans and grants minus repayments, net aid. Loans are included here because in Ghana it has been the policy of government to contract loans that are concessional; the result is that almost all loans

contracted have a grant element, currently around thirty five percent (Ministry of Finance and Economic Planning).

**EMPIRICAL ANALYSIS**

 **RESULTS OF STATIONARY TEST**

A time series is non-stationary if its moments are not time variant. It is said to be stationary if the mean and auto covariance of the series do not depend on time. Stationary test was performed on all the variables using the Augmented Dickey-Fuller tests (ADF). The test was performed on the null hypothesis ($H_o$) the series is non-stationary. The decision rule is to reject Ho and accept $H_1$ if the calculated value is greater than the table value/critical values at 95% confidence level and vice versa. Table 1

below reports the DF and ADF tests done on the variables with first with only a constant and second with constant and trend.

The DF and the ADF tests are reported separately for regressions with only the lagged dependent variable and with the addition of a constant term (C) and with time trend (T).

The results indicate that the majority of the time series have a simple unit root. This is analytically convenient since stationarity is achieved by first differencing.

**TABLE 1**

DF AND ADF UNIT ROOT TEST FOR VARIABLES AT THEIR LEVELS

| VAR | DF | ADF | C.V. | DFT | ADF | C.V. |
|---|---|---|---|---|---|---|
| LRY | -2.5338 | -1.9839 | -2.9558 | -2.4969 | -1.9516 | -3.5562 |
| LRMS | -1.3614 | -1.3906 | -2.9558 | -1.3067 | -1.3383 | -3.5562 |
| LRG | -0.8394 | -1.1118 | -2.9558 | -0.7894 | -1.0392 | -3.5562 |
| RNX | -4.2894 | -2.2251 | -2.9528 | -5.6146 | -3.2866 | -3.5514 |
| LRS | -2.9885 | -2.1116 | -2.9528 | -3.0805 | -2.1954 | -3.5514 |
| RAID | -4.5106 | -2.9716 | -2.9558 | -4.4293 | -2.9749 | -3.5562 |
| RER | -1.6889 | -2.9072 | -2.9499 | -1.7130 | -2.8893 | -3.5468 |
| LP94 | -0.4185 | -0.0290 | -2.9528 | -2.0613 | -2.1255 | -3.5514 |

From above, comparing the t-values with the critical values, we accept the null hypothesis that the series is non-stationary at their levels.

The test was then carried on the first difference of each of the variables and they were all found to be stationary (see table 2 below). This implies

that all the series in table 1 are integrated of order one, i.e. I (1) and also have a lag length of one.

**TABLE 2**

UNIT ROOT TEST FOR VARIABLES AT FIRST DIFFERENCES

| VAR | DF | ADF | C.V. | DF(trend) | ADF(trend) | C.V. | Lags |
|------|---------|---------|---------|-----------|------------|-----------|------|
| DLRY | -7.2478 | -4.7742 | -2.9591 | -7.1237 | -4.6904 | -3.5615 | 1 |
| DLRMS | -9.8136 | -7.4740 | -2.9627 | -9.6496 | -7.341 | I -3.5671 | 1 |
| DLRG | -8.0703 | -7.0253 | -2.9627 | -7.9736 | -6.8864 | -3.5671 | I |
| DLRR | -4.8534 | -3.8831 | -2.9558 | -4.8885 | -3.9623 | -3.5562 | 1 |
| DRLNX | -10.9874 | -7.2082 | -2.9558 | -10.8227 | -7.1634 | -3.5562 | I |
| DLRS | -8.1865 | -5.0197 | -2.9558 | -8.0494 | -4.9329 | -3.5560 | 1 |
| DRAID | -7.6245 | -5.5371 | -2.9591 | -7.4076 | -5.3248 | -3.5615 | 1 |
| DLP94 | -9.9335 | -6.8908 | -2.9591 | -9.9197 | -7.0344 | -3.5615 | I |

These series exhibit the characteristics of the random walk with one unit root.

**RANK AND ORDER CONDITION**

The two equations are over identified by the rank condition given that k = 10, G =2 and M in both equations =5. Both equations satisfy the rank condition that is we are able to construct one non-zero determinant from the coefficient of the variables excluded from these equations. This means that the equations can be estimated and the appropriate estimations procedure is the Two stage least squares (2SLS / TSLS). According to Ramanathan (1995) the TSLS can be applied to obtain unique estimates that are consistent and asymptotically efficient. It can be applied in both cases when the model is exactly identified or over identified.

The TSLS method is a single equation applied to one equation of system at a time. It provides satisfactory results for the estimates of structural parameters and is accepted as the most important of the single equation techniques for the estimation of over identified models. Theoretically TSLS may be considered as an extension of indirect least squares (ILS) and of the instrumental variable (NY) method. The method of the TSLS would therefore be applied to the set of reduced form equation to estimate the parameters of the equations above.

**RESULTS OF TWO STAGE LEAST SQUARES REGRESSION**

This section presents the results of the two-stage least squares regression of the reduced form equations of the AD and AS equations. An overall assessment of each equation is done with reference to the summary statistics examine its performance.

**EFFECTS OF AID ON OUTPUT GROWTH**

Table 3 below shows TSLS estimation results of the AD equation. The equation is meant to capture especially the impact of aid on the

growth of output in Ghana for the period under consideration. The variables of this equation are GDP (DLRGDP), prices (DLP94), aid (DRAID), government expenditure (DLRG), net exports (DRNX), savings, time trend T, and a constant C.

**TABLES.3**

TWO STAGE LEAST SQUARES RESULTS OF THE IMPACT OF AID ON OUTPUT

| Regressor | Coefficient | Standard Error | T-Ratio | Prob. |
|-----------|-------------|----------------|---------|-------|
| DRAID | .9617E-4 | .5413E-4 | 1.7765 | (.087) |
| DLRG | .16464 | .097998 | 1.6801 | (.051) |
| DRNX | -0.2952E-4 | .1467E-4 | -2.0126 | (.055) |
| DLRS | 0.025453 | .053884 | 0.47236 | (.641) |
| C | 7.8836 | .54188 | 14.5487 | (.000) |

R-Squared .85193

G-R Squared .85193

R-Bar-Squared .82791

G-R-Bar Squared .82791

F-stat. F (7. 24) 8.4734

F·PROB. (.000)

DW-statistic 2.0199.

**DIAGNOSTIC TESTS**

SERIAL CORRELATION =2.5672 (0.501)

FUNCTIONAL FORM = 0.2155E-3 (0.678)

NORMALITY =0.52299 (0.677)

HETEROSKEDASCITY=0.7735E-3 (0.879)

The coefficients of multiple determinations ($R^2$) of 0.85 indicates a good fit. It implies that the regressors of the aggregate demand equation explain 85% of the variation in GDP in Ghana. In instrumental variable estimation where the instruments coincide with the independent variables, a more reliable measure of fit is the generalized r-squared ($GR^{-2}$) and the generalized r-bar-squared ($GR^2$). This measure allows for the dependence of the regressors and the disturbances and simplifies the analysis to the standard r-squared type measure. The F-statistic of 8.8764 exceeds the theoretical F (2.42) at 5% significant level. This means that the regressors do jointly explain the dependent variable. The corresponding probability of 0.000 indicates a 100% confidence that the regressors jointly determine the GDP in Ghana.

**DISCUSSION OF RESULTS**

Table 5.3 shows the results of the aggregate demand equation. Real GOP (DLRGDP) is explained by real aid (DRAID), real government spending (DLRG), real net exports (DRNX), real savings (DLRS), and a constant (C). All coefficients except real savings are significant and have the expected a priori signs and are significant at conventional levels. In a situation where the dependent variable is logged and the independent variable is not like we have in this model, every unit change in the independent variable is expected to multiply

the dependent variable by $10^x$, where x is the calculated coefficient The coefficient of real aid of 0.00009617 therefore implies that a unit change in real foreign aid will change real GOP by 1.00022 ($10^{0.00009617}$). A unit change in real aid contributes 1/10000 to GDP growth. In absolute terms, this is very insignificant. Statistically however the coefficient is positive and significant at 10 percent level of significance. The t-statistic of 0.087 however implies the coefficient is significant. This is supported by Mosley (1980) who in his study on the impact of aid on growth concludes that though aid is significant in the growth of output. This finding supports the supplemental theorist's view that aid supplements savings and enables a country to maintain the level of investment needed for economic growth. Government expenditure has a positive coefficient, which is consistent with expectations. The coefficient of 0.16464 implies that a 100% change in real government expenditure will increase real GDP by 16%. The t-probability of 0.051 means the variable is significant in determining variations in real GDP. Net exports have a negative coefficient and this is particularly true of the Ghanaian economy where imports exceed exports and net export is likely to be a leakage rather an injection. The coefficient of 0.29552E-4 is statistically significant and implies that a unit change in real net exports will change real GDP by 1.00006.

The DW-statistic of 2.0199 shows the absence of any serious serial correlation.

## IMPACT OF AID ON INFLATION

Table 4 below shows TSLS estimation results of the AS equation. The equation is meant to capture the impact of aid on inflation in Ghana for the period under consideration.

**TABLES.4**

IMPACT OF AID ON INFLATION

| Regressor | Coefficient | Standard Error | T-Ratio | [Prob.] |
|---|---|---|---|---|
| DRAID | -0.6680E-5 | 0.2512E-4 | 0.26597 | [.079] |
| DLRMS | 0.77366 | 0.11479 | 6.7395 | [.000] |
| DLRR | -0.14932 | 0.079260 | 1.8839 | [.070] |
| C | 2.5925 | 0.76224 | 3.4011 | [.002] |
| T | 0.29725 | 0.024075 | 2.3467 | [.000] |

R-Squared 0.99924 G-R Squared 0.99924

R-Bar-Squared 0.99906 G-R-BAR Squared 0.99906

F-stat. F (6, 25) 5464.4

F-PROB[.000]

DW-statistic 1.9977

**DIAGNOSTIC TEST**

SERIAL CORRELATION= 2.5207 (0.452)

FUNCTIONAL FORM =0.17171 (0.657)

NORMALITY =1.0613 (0.858)

HETEROSKEDASTICITY = 0.21314 (0.774)

The $R^2$ of .99924indicated a good fit. It implies that 99% of variations in the regress and is explained by the regressors. The regressors do not explain only about 1% of the variability in the dependent variable. The GK2 also point to the fact that about 99% of variations in the price level is explained by the variables in the equation.

The high F- statistic value of 5464.4 exceeds the theoretical value of 3.63 at 1% significant level. This indicates that the regressors jointly explain the dependent variable. The F-probability of 0.0000 indicates a 100 percent confidence that the regressors jointly determine the level of prices in Ghana. The DW statistic of 1.9977 indicates there is no problem with serial correlation. The model was further subjected to rigors test to tests its stability. The test also shows that the model was properly formulated. The Lagrange multiplier test for residual serial correlation was performed and it shows the presence of no serial correlation. The test is conducted on the null hypothesis that there is the presence serial correlation. The results makes us fail to accept the null hypothesis and accept the alternate hypothesis that there is no serial correlation. The functional form was also tested using the Ramsey reset test using the square of the fitted values. The result also has a probability of 0.657 and so we accept the alternate hypothesis that there is no problem with the functional form.

## DISCUSSION OF RESULTS

A look at table 4 shows that all coefficients achieved their a priori expected signs. All coefficients are essentially significant at conventional levels i.e. 10%. Following from the analysis on the demand side of the model, a unit change in real aid will change the general price level by 0.9999 ($l0^{-0.0000066S}$). A unit change in real aid will decrease price levels by 1110000. This is consistent with the work of Brutton and Hill (1990) who concluded that aid is disinflationary. In this model real money balance is also significant as shown by the t-statistic. The coefficient of 0.77366 implies that a change in real money balances by 100% will affect price levels by as much as 77%. This implies a strong relationship between real money balances and price levels. Real interest rate has the expected negative sign in line with economic theory. The coefficient of 0.77366 is statistically significant and implies that increases of 100% in interest rates will impact on price level by 14% over the same period. This is particularly true because increases in interest rate may crowd out investment. The constant term has a coefficient of 2.5925 and is statistically significant. The time trend is introduced in this model because the variables exhibit a random walk pattern and it also proxies' technology. It has a coefficient of 0.29725 and is statistically significant with a t-probability of 0.000.

## CONCLUSIONS

The analysis shows that the assumption that foreign aid enhances output growth through increases in savings and hence GDP is true for Ghana for the period under review. Changes in

real GDP attributable to a unit change in foreign aid positive. Foreign aid has a negative coefficient in the supply model and has a disinflationary impact; this conforms to empirical research conducted in some economies. Foreign aid, which comes mostly in the form of grants and concessional loans, has also increased the country's debt burden.

## POLICY IMPLICATIONS

The impact of aid on GDP in the model has been found to be positive and proportionate in the model for the period under consideration. In view of the findings of the study, the country should channel the aid inflows in to areas of the economy where it will yield maximum returns in the shortest possible time. Since part of these monies will be paid back, it should be put in directly productive sectors of the economy, this way it will add to the nation's income in a short time and help with repayment. Areas in agriculture and manufacturing are very important sectors and should be given priority in distributing these resources. Small irrigation projects can be built to increase agricultural productivity for both domestic and foreign markets. There is also the need to source for untied aid. As well as receiving more good quality' aid, that is not tied to expensive imports, and can be disbursed quickly, without lengthy delays due to cumbersome donor procedures, as can be achieved through programme aid. Donors are requested to provide more timely information on grants as this will assist the Government to improve its recording and monitoring of aid flows. In addition, it will also enable the Government to forecast more accurate the aid pipeline for budgetary and balance of payments purpose.

## LIMITATIONS OF THE STUDY

This study may have some problems. The use of secondary data in analysis of this nature can be misleading. This stems from the fact that secondary data may not be actual but estimates. This problem has been reduced however in this study by conducting stationarity tests on the data set and making the necessary adjustments to make them stationary where they were found not to be stationary. Foreign aid inflow is not well documented. A lot of aid comes in kind other than cash and it is hard to find data on actual of these forms of aid. Data on the aid that comes directly to communities and institutions are not documented. This means that it is likely a substantial amount of information is lost to this analysis, which if available may have changed the results of this study. A study of the impact of aid to the various sectors of the economy would actually paint a better picture of the impact of this massive capital inflow on the economy of Ghana but lack of efficient data on foreign aid inflow makes it impossible to embark on such an enterprise.

## DIRECTION FOR FUTURE RESEARCH

In view of the limitations of the study attempts should be made by the government to streamline all aid flows into the country and

adequate records should be kept on these flows. More research should be done on the impact of aid inflows on all sectors of the economy. This should be done for each sector so that a critical analysis could be done to advice government on its policies on aid.

## References

Aryeetey, E. and Cox, A., (1997). "Aid and Effectiveness in Ghana." in Carlsson, et al (eds), *Foreign aid in Africa: Learning from Country's Experience,* Uppsala: Nordiska Afikainstitutet.

Baah-Nuakoh, A., (1996). *Exporting Manufactures from Ghana: Is Adjustment Enough?* Overseas Development Institute, London.

Bacha, E., (1990). "A Three-Gap Model of Foreign Transfers and the GDP Growth Rate in Developing Countries." *Journal of Development Economics,* No., 32,279-96.

Bauer, P. T., (1984). *Reality and Rhetoric: Studies in the Economic Development,* London: Weindenfeld and Nicholson.

Bhaduri, A. and Skarstein, R., (1993). *Evaluation of Macroeconomic Impact of import Support to Tanzania.* Trondheim University, Norway.

Bhalla, S. S., (1991). "Economic Policies, Foreign Aid, and Economic Development in Sri Lanka." *Bulletin of the Oxford University Institute of Economic and Statistics,* Vol. 33, 156-161.

Binh, T. and McGillivray M., (1993). "Foreign Aid, Taxes and Public Investment: a

Comment." *Journal of Development Economics,* Vol. 41,234-255.

Boone, P. (1995). *Politics and Effectiveness of Foreign Aid.* London School of Economics, Centre for Economic Performance, London.

Bruton, H. and Hill, C., (1990). *The Development Impact of Counterpart Funds: a Review of the Literature.* USAID, Washington D. C.

Chern, F., (1992). "Structural Adjustment, Primary Resource Trade and SustainableDevelopment in Sub-Saharan Africa." *World Development* No. 20,497-512.

Collier, P. and Gunning J. W. (l992). "Aid and Exchange Rate Adjustment in African Trade Liberalizations." *Economic Journal,* Vol. 102,925-939.

Cornia, G., (1991). "Is Adjustment Conducive to Long-term Development? The Case of Africa in the 1980s." *Centro Studi Luca d 'Agliano/Queen Elizabeth HouseDevelopment studies Working papers* 42. Queen Elizabeth House, Oxford.

de Mello L. R., (1997). "Foreign Direct Investment in Developing Countries and Growth: a Selective Survey." Journal of Development Studies, No. 34 1-34.

Demery, L, (1993). *Assessment of the Interrelation between Adjustment Financing and Economic Performance in SPA Countries.* Process, World Bank,Washington DC.

Devarajan, S., Rajkumar, A. S., and Swaroop, V., (1999). *What Does Aid do to Africa?*

Development Research Group, World Bank, 45-78.

Dordunoo, C. K, (1994). "The Foreign Exchange Market and the Dutch Auction System in Ghana." *Research Paper,* No., 24, A.E.R.C., Nairobi.

Doriye, J. and Wuyts M. (1992). "Adjustment and Sustainable Recovery: the Case of Tanzania," SOAS Department of Economics, *Working paper* No.6, SOAS, London.

Doriye, J., White, H., and Wuyts, M., (1993). *Fungibility and Sustainability: Imports Support to Tanzania:* SIDA Evaluation Report, Vol. 93/5 SIDA, Stockholm.

Doroondia, K. (1993). "Macroeconomic Performance and Adjustment under the Policies Commonly Supported by the International Monetary Fund." *Economic Development and Cultural Change,* Vol. 41, 859-864,

Ekman. 8., and Metell, K., (1993). Foreign Aid Fundgibility: the Kenyan Case, *Unpublished MA Thesis* [Stockholm University, Stockholm].

EI Shibly, M., (1984). "Foreign Capital Inflow, Domestic Savings and Economic Growth: the Experience of Sudan." *Journal of Economic Development,* Vol., 9, 125-45.

Fitzgeralde, V. K., and Sarrnad, K., (1990). "External Shock and Domestic Response in Less Developed Countries: A Cross-Country Decomposition 1970-1988." *Working Paper-Sub-series on Money, Finance and Development.* Vol. 35, Institute of Social Studies, The Hague.

Forster, N., (1993). "A Developing Country's Fiscal Response to Foreign Aid: the Case of Papua New Guinea, 1970-88." *Working Paper,* National Centre for Development Studies, Australian National University, Canberra.

Fuller, W. A., (1976). *Introduction to Statistical Time Series.* John Wiley and Sons. New York.

Gang, I. N., and Khan, H. A., (1991). "Foreign Aid, Taxes and Public Investment." *Journal of Development Economics,* Vol. 34,355-369.

Gang, I., (1993). "Foreign Aid, Taxes and Public investment: Comment by Tran Nam Binh and McGillivray-Reply." *Journal of Development Economics,* Vol. 41, 368-

Jesperson E., (1992). "External Shocks, Adjustment Policies and Economic and Social Performance." In Cornia G. A., R. Van der, Hoeven and Mkandawira T., Eds.,Africa's Recovery in the 1990's, From Stigmatic and Adjustment to HumanDevelopment. St Martins Press, 9-90, New York.

Levine, R., and Rendt, D., (1991). "Cross-Country Studies of Growth and Policy: Some Methodological Conceptual and Statistical Problems." *World Bank Working Paper.* No. 608, World Bank, Washington DC.

Ministry of Finance, (1999). *Study of Aid flows: Budget. Balance of Payments and Monetary Effects.* Ghana Publishing Corporation. Tema.

Mosley, P., Hudson, J" and Horrell, S., (1992). "Aid, the Public Sector and the Market in Less Developed Countries: A Return to the Scene of the Crime." *Journal of International Development,* No., 4, 139-150.

Ogun,O ., and Kingu, A. A., (1995). "Money Supply Mechanisms in Nigeria (1970-89)."*AERC, Research Paper,* No. 39, Nairobi, Kenya.

Snyder, D., (1990). "Foreign Aid and Domestic Savings: a Spurious Correlation?" *Economic Development and Cultural Change,* Vol. 38, 175-181,

Teye, J., Mosley, P. and Harrigan, J., (1991). *Aid and Power: The World Bank and Policy Based Lending,* Routledge, University of Press, 1081, Washington D. C.

Todaro, M. P., (1992). *Economic Development in the Third World,* 4th ed., Longrrm

Singapore.

Tsikata, Y., (1999). *Aid and Reform in Ghana.* Economic and Social Research Foundation, Dar es Salaam, Tanzania.

White, H., (1994). *The Country- Wide Effects of Aid.* Institute of Social Studies, The Hague.

World Bank, (1998). "Assessing Aid: What Works, What doesn't and Why". *World Bank Policy Research Report,* Oxford University Press, Oxford.

Younger, S., (1992). "Aid and the Dutch Disease: Macroeconomic Management when Everybody Loves You." *World Development.* Vol. 2

# Explaining Entrepreneurial Intentions by Means of the Theory of Planned Behaviour

**John Mbah Aduku[1] & Eunice Antiaye[2]**
[1]Afrique Research Bureau (Monitoring and Evaluation Department)
[2]Accra Polytechnic (Fashion and Designing Department)
adukujohn@gmail.com

**Abstract**

This study seeks to apply the generally accepted model of entrepreneurial intentions, by Shapero in the Ghanaian context, focusing on the students in both the public and Private Chartered Universities in Ghana. The study will aim to elucidate on the specific circumstances in the students environment, as well as personal disposition which may have significant influence on their choice to create new ventures. The sample size was 150 respondents. The data collection instruments were questionnaire. Quantitative data collected was analyzed by descriptive statistics using SPSS and presented through percentages, means, standard deviations and frequencies. Content analysis was used on data that is qualitative nature or aspect of the data collected from the open ended questions. The results of this study were compared to other similar studies of the same correspondent in other universities to enable general conclusions on the applicability of the model and the authenticity of the results. Should one want to stimulate entrepreneurship in educational or training settings, then our results provide guidance. The study concludes that it was very possible to offer entrepreneurship courses since they develop the intention and the necessary abilities to be an entrepreneur and that being an entrepreneur would entail great satisfactions. The study further concludes that the respondents had complete knowledge on both readily available opportunity to start the businesses and business centres/networks.

**Keywords**: entrepreneurialism; entrepreneurial-career-choice; entrepreneurial-intentions; Business-start-ups, theory-of-planned-behaviour.

## 1.0 INTRODUCTION

Entrepreneurship theories and research remain important to the development of the

entrepreneurship field. Several theories have been put forward by scholars to explain the field of entrepreneurship. Studies have also tried to link entrepreneurial intentions to venture creation (Carter et al, 2011; Kolvereid, 2012; Krueger et al., 2010).

Models based on Ajzen theoretical framework continue to dominate social psychological research into intentions. Intentions represent the degree of commitment toward some future target behavior. Intentions robustly predict and explain that behavior. In turn, attitudes toward a behavior will affect intentions. Exogenous factors influence intentions and behavior through these attitudes. In their theory of reasoned action, attitudes toward a behavior consist of two components: an attitude based on expectancies and an attitude based on social norms (Ajzen, 1987). Ajzen's theory of planned behavior takes these attitudes representing the attractiveness of a behavior and adds another attitude, perceived behavioral control. This represents perceptions that the behavior is within the decision maker's control, a necessary precondition for the behavior to be personally feasible (Ajzen, 1987). "Intentions" here refers to the specific target behavior of starting a business. This goal behavior is, by definition, planned. Usually, though, the plan or vision of how to achieve the goal and the specific details of the goal are formulated after identifying the intended goal, since starting a business constitutes a complex, distal behavior, intentions (end) and the plan (means) will likely co-evolve.

Shapero suggests that the process of forming intentions may prove complex. Propensity to act is likely to also have indirect influences on relationships in the model, thus we should test for moderating effects by propensity to act. Shapero also suggests that intentions may depend on only a threshold level of feasibility and desirability perceptions, thus we may also want to attempt identification of threshold effects. In Ghana, the informal sector has rapidly expanded and now provides numerous opportunities for self-employment. In 2007-2012 for example, the formal sector grew by only 1.8% compared to 3.5% growth for the informal sector. Unfortunately, the sector continues to be unattractive to the more educated youth creating a skills gap that curtails its growth (ISSER, (2012). This study seeks to apply the generally accepted model of entrepreneurial intentions, by Shapero in the Ghanaian context, focusing on the students in both the public and Private Chartered Universities in Ghana. The study will aim to elucidate on the specific circumstances in the students environment, as well as personal disposition which may have significant influence on their choice to create new ventures.

This study answers a number of research questions that is; 1) how does the perceived desirability influences entrepreneurial intention amongst university students in Ghana? 2) Does the propensity to act influence entrepreneurial intention amongst university students in Ghana? 3) How does the perceived feasibility influence entrepreneurial intention amongst university students in Ghana?

## 1.2 Theoretical Framework

The majority of theoretical works that focus on the study of entrepreneurial intentions are based on the theory of planned behavior (TPB) (Ajzen, 1987) and the model of the entrepreneurial event (Krueger et al., 2010; Kolvereid, 2012). These procedures provide a similar explanation of entrepreneurial intention of the individual and provide a coherent framework, simple and robust to achieve a better understanding of the process of business creation (Krueger et al., 2010). Similarly, this framework allows us to highlight the main determinants influencing the passage of the desirability to realization of the intention to undertake in following the model of the entrepreneurial event (Schapero & Sokol, 1982).

The evaluation of the impact of different variables mentioned by the theoretical framework can be done through the use of an empirical test. Such a test makes use of a well-specified and dedicated to the estimation of the coefficients of structural equations involving qualitative variables including the desirability and feasibility of entrepreneurial econometric model.

## 2.0 METHODOLOGY

The paper used a descriptive survey design. Kothari (2009) refers to diagnostic and descriptive design as concerned with providing characteristics of a particular phenomenon while determining the frequency of level of association with something else. Therefore descriptive statistics was used to inspect the

data and identify any existing trends. The population of the study comprised of university students taking Entrepreneurship education in both public and Private Chartered Universities**.**

**Table 2.1** Sample Size

| Schools | Number |
|---|---|
| University of Ghana | 50 |
| University of Professional Studies | 50 |
| Valley View University | 50 |
| Total | 150 |

Krueger *et al.* (2010) argue the importance of papering entrepreneurial phenomena before they occur, and in order to be able to differentiate between groups, to include non-entrepreneurial intending subjects, target population of the paper included undergraduate students undertaking specialization in entrepreneurship in both public and private chattered universities in Ghana.

The analysis involved different phases, phase one was frequency analysis of the background data to determine the sample characteristics and profiles of the students interviewed. In phase two, the focus was on correlation and descriptive analysis of the independent variables. This assisted in making conclusions on the identified hypotheses. The analysis sought to answer all research questions that have been identified in the paper. A structured questionnaire was used as the main data collection tool in the current paper. The first

section on the questionnaire measured demographic characteristics of students such as gender, age, faculty, race, employment status and income. The second section of the questionnaire measured the main paper variables that constructed the models tested here. Analysis of variance (ANOVA) was used to investigate the degree of relationship between the variables in the paper; indicated the strength and direction of association between the variables.

## 3.0 RESULTS AND DISCUSSIONS

The paper targeted 150 respondents in collecting data with regard to the determinants of entrepreneurial intentions among university students in Ghana. According to the findings, 65% of the respondents were male while 35% of the respondents were female.

|  | Stron Agr | Neut ral | Disag | Strongly | Mean | Std |
|---|---|---|---|---|---|---|
| Knowledge about | 90 | 20 | 20 | 10 | 10 | 26 | 0.6 |
| Greater recognitio | 60 | 40 | 30 | 10 | 10 | 24 | 0.6 |
| The preference | 60 | 40 | 30 | 10 | 10 | 24 | 0.6 |
| The necessary | 60 | 40 | 30 | 10 | 10 | 24 | 0.5 |
| The intention | 50 | 50 | 10 | 20 | 20 | 28 | 0.6 |

Source: Research, 2015

The paper sought to find out the possibility of offering entrepreneurship courses which develop the stated entrepreneurial aspects. According to the findings, the respondents indicated that it was very possible to offer entrepreneurship courses since they develop the intention to be an entrepreneur as indicated by a mean of 29, the respondents indicated that it was very possible to offer entrepreneurship courses since they develop the necessary abilities to be an entrepreneur as indicated by a mean of 24, the respondents indicated that it was possible to offer entrepreneurship courses since they develop the preference to be an entrepreneur, greater recognition of the entrepreneur's figure and knowledge about the entrepreneurial environment as indicated by a mean of 26.

### 3.1 Perceived Desirability

**Table 4. 1:** Offering entrepreneurship courses which develop entrepreneurial aspects

### 3.2 Perceived Feasibility

**Table 3. 2:** Level of detailed knowledge on measures to support firm creation

| | Strong Agree | Agree | Neutral | Disagree | Strongly Disagree | Mean | Std Dev |
|---|---|---|---|---|---|---|---|
| Specific training for | 90 | 20 | 20 | 10 | 10 | 26 | 0.6 |
| Loans in specially favourable terms | 60 | 40 | 30 | 10 | 10 | 26 | 0.6 |
| Technical aid to start the business | 60 | 40 | 30 | 10 | 10 | 26 | 0.6 |
| Business centres/networks | 60 | 45 | 25 | 10 | 10 | 25 | 0.5 |
| Consulting services in favourable terms | 60 | 45 | 25 | 10 | 10 | 25 | 0.5 |
| Market accessibility in favourable terms | 60 | 40 | 30 | 10 | 10 | 24 | 0.5 |
| Favourable policies to | 60 | 40 | 30 | 10 | 10 | 24 | 0.5 |
| Readily available opportunity to start | 65 | 50 | 5 | 20 | 20 | 29 | 0.6 |

Source: Research, 2015

The paper sought to find out the level of detailed knowledge of the respondents on measures to support firm creation. According to the findings, the respondents indicated that they had complete knowledge on both readily available opportunity to start the businesses and business centres/networks as indicated by a mean of 29 and 25 respectively. The respondents indicated that they were knowledgeable on specific training for young entrepreneurs, consulting services in favourable terms and favourable policies to start businesses as indicated by a mean of 26, the respondents indicated that they were knowledgeable on technical aid to start the business as indicated by a mean of 25, the respondents indicated that they were knowledgeable on loans in specially favourable terms and market accessibility in favourable terms as indicated by a mean of 24.

## 3.3 Propensity to Act

**Table 3.3:** Behaviours to develop your enterprise

| | Strong | | Neutral | | Strongly | Mean | Std Dev |
|---|---|---|---|---|---|---|---|
| Exporting a significant share of production | 90 | 20 | 20 | 10 | 1 0 | 26 | 0.6 |
| Introducing regularly new products/services | 60 | 40 | 30 | 10 | 10 | 24 | 0.6 |
| Introducing regularly new processes or | 60 | 40 | 30 | 10 | 10 | 24 | 0.6 |
| Developing Research | 60 | 40 | 30 | 10 | 10 | 24 | 0.5 |
| Planning the different areas of the firm with | 60 | 40 | 30 | 10 | 10 | 24 | 0.6 |

| Reaching cooperation agreements or | 60 | 40 | 30 | 10 | 10 | 24 | 0.6 |
|---|---|---|---|---|---|---|---|
| Offer specialized training for employees | 60 | 40 | 30 | 10 | 10 | 24 | 0.6 |
| Enlarging your firm (personnel, premises, | 70 | 55 | 5 | 10 | 10 | 29 | 0.6 |

Source: Research, 2015

The paper sought to find out the extent to which the respondents would perform the stated behaviours to develop their enterprise. According to the findings, the respondents agreed that introducing regularly new processes or systems of production developed their enterprise as indicated by a mean of 24, the respondents agreed that introducing regularly new products/services for the costumers developed the enterprise as indicated by a mean of 24 ,the respondents agreed that introducing an offer specialized training for employees developed the enterprise as indicated by a mean of 24 ,the respondents agreed that enlarging the firm developed the enterprise to a great extent as indicated by a mean of 27 ,the respondents agreed that exporting a significant share of production developed the enterprise to a great extent by a mean of 2.6, the respondents agreed that developing research and development projects and planning the different areas of the firm with detail developed their enterprise to a great extent as indicated by a mean of 25 and reaching cooperation agreements or partnerships with other firms developed the enterprise to a little extent by 24. This was in line with studies done by Krueger in 1993. The paper found out that when propensity to act was low, entrepreneurial intentions were unlikely to develop, and perceptions of desirability become sole predictors of intentions.

## 3.4 Regression Analysis

The researchers conducted a multiple regression analysis. This was done to test relationship among variables (independent) on the entrepreneurial intentions among university students in Ghana. The statistical package for social sciences (SPSS) was applied to code, enter and compute the measurements of the multiple regressions for the paper.

**Table 3. 4:** Model Summary

| Model | R | R Square | Adjusted R Square | Std. Error of the |
|---|---|---|---|---|
| 1 | 0.790(a) | 0.620 | 0.541 | 0.85945 |

**Source: Research, 2015**

Coefficient of determination explains the extent to which changes in the dependent variable can be explained by the change in the independent variables or the percentage of variation in the dependent variable (Entrepreneurial Intentions) that is explained by all the three independent variables (Perceived Desirability, propensity to Act, Perceived Feasibility). The three independent variables that were studied, explain only 62% of the factors affecting entrepreneurial intentions among university students in Ghana as represented by the $R^2$. This therefore means that other factors not studied in this research contribute 36 % of the

entrepreneurial intentions among university students in Ghana. Therefore, further research should be conducted to investigate the other factors (26%) that affect entrepreneurial intentions among university students in Ghana.

**Table 3.5:** ANOVA (b)

| Model | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Regression | 19.3695 | 3 | 6.4565 | 7.474 | 0.000(a) |
| Residual | 11.2305 | 26 | 0.864 | | |
| Total | 30.6000 | 29 | | | |

**A Predictors:** (Constant), perceived desirability, propensity to act, perceived feasibility b Dependent Variable: entrepreneurial intension. The significance value is 0.000 which is less than 0.05 thus the model is statistically significance in predicting how perceived desirability, propensity to act, perceived feasibility affect the entrepreneurial intentions among university students in Ghana. The F critical at 5% level of significance was 1.32. Since F calculated is greater than the F critical (value = 7.474), this shows that the overall model was significant.

**Table 3.6: Coefficients (a)**

| Model | Un-standardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|
| | B | Std. Error | Beta | | |
| (Constant) | 0.223 | 0.769 | | 0.290 | 0.004 |
| Perceived desirability | 0.867 | 0.148 | 0.757 | 5.869 | 0.000 |
| Propensity to act | 0.115 | 0.123 | 0.935 | 0.115 | 0.123 |
| Perceived feasibility | 0.095 | 0.138 | 0.092 | 0.668 | 0.007 |

a) Dependent Variable: Knowledge about the entrepreneurial environment

Source: Researchers, 2015

a) Dependent Variable: Knowledge about the entrepreneurial environment**.** The researchers conducted a multiple regression analysis so as to explaining entrepreneurial intentions among university students in Ghana.

And the three variables as per the SPSS generated table 4.6, the equation ($Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon$) becomes: Y= 0. 867$X_1$+ 0.

$115X_2 + 0.095 X_3 + 0.223$. Where Y is the dependent variable (entrepreneurial intentions), $X_1$ is the perceived desirability variable, $X_2$ is propensity to act and X3 is perceived feasibility. According to the regression equation established, taking all factors into account (perceived desirability, propensity to act, perceived feasibility) constant at zero, entrepreneurial intentions will be 0.113. The data findings analyzed also showed that taking all other independent

variables at zero, a unit increase in perceived desirability will lead to a 0.437 increase in entrepreneurial intentions; a unit increase in propensity to act will lead to a 0.115 increase in entrepreneurial intentions, a unit increase in perceived feasibility will lead to a 0.095 increase in entrepreneurial intentions. This infers that perceived desirability contribute more to entrepreneurial intentions among university students in Ghana followed by the propensity to act strategies. At 5% level of significance and 95% level of confidence, perceived desirability had a 0.000 level of significance, propensity to act showed a 0.008 level of significant, perceived feasibility showed a 0.007 level of significant hence the most significant factor is perceived desirability.

**3.5** Hypotheses Testing

**Table 3. 7: Chi-Square Tests**

|  | Value | DF | P-Value |
| --- | --- | --- | --- |
| **Chi-square** | 1.36 | 150 | 0.023 |

Source: Researchers, 2015

The calculated Pearson Chi-Square value is 1.36. The associated P-Value (Asymptotic significance) is 0.023. This value is less than 0.05 (5% level of significance) indicating that there is evidence against the null hypotheses and therefore we reject it. A conclusion can be drawn from the paper that 'Individual perception of the desirability of a venture affects the entrepreneurial intentions of university students in Ghana"

**Table 3.8:** Chi-Square Tests propensity and the entrepreneurial intentions of university students in Ghana

|  | Value | Df | P-Value |
| --- | --- | --- | --- |
| *Chi-Square* | 3.26 | 150 | 0.014 |

The Pearson Chi-square Value was 3.26 and the associated P- value (Asymptote Significant Value) was 0.014. This value is less than 0.05 indicating that there is evidence against the null hypotheses and therefore we reject it. A conclusion can therefore be drawn that the propensity to act has a great influence on the entrepreneurial intentions of university students in Ghana.

**4.0 CONCLUSION**

The paper concludes that it was very possible to offer entrepreneurship courses since they develop the intention and the necessary abilities to be an entrepreneur and that being an entrepreneur would entail great satisfactions. Introducing regularly new processes or systems of production and new products/services for ones costumers developed their enterprise. Finally the paper concludes that the respondents had complete knowledge on both readily available opportunity to start the businesses and business centres/networks. Economic opportunity and autonomy are very important in making a choice whether to become an entrepreneur and that carrying out the kind of job one really likes corresponds to entrepreneurial success. The paper recommends that learning institutions should offer entrepreneurship courses. This will enable the learners to have the knowledge about the entrepreneurial environment and realize the necessary abilities needed to be entrepreneurs. The paper further recommends that the government should provide funds as capital for those who want to venture in entrepreneurship. In addition, the paper recommends that the government should develop research and development projects that will help in giving more information on the field of entrepreneurship. Finally the paper recommends that entrepreneurship based organizations should hold trade fairs and seminars as this will ensure that the entrepreneur's role in the economy is sufficiently recognized.

**References**

Ajzen, I. (1987). Attitudes, traits and actions: *Dispositional prediction of behavior in social psychology.* Advances in Experimental Social Psychology, 20, 1-63.

Carter, N., Gartner W., Shaver K. & Gatewood E. (2011). The career reasons of nascent entrepreneurs. *Journal of Business Venturing, 18: 13-39.*

Kolvereid, L. (2012) Prediction of employment status choice intentions. *Entrepreneurship Theory and Practice, 21(1), 47-57.*

Kothari, C. R. (2009), *Research Methodology: Methods and Techniques*. New Delhi: Wiley.

Krueger N.F.J., Reillly, M.D. & Carsrud A.L. (2010). Competing models of entrepreneurial intentions. *Journal of Business Venturing*, 15(5): 411-432

Shapero, A. & Sokol, L. (1982). *The social dimensions of entrepreneurship.* In The Encyclopedia of entrepreneurship (pp. 72-90). Englewood Cliffs, NJ: Prentice Hall.

Shapero, A. (1975). *The displaced, uncomfortable entrepreneur*. Psychology Today, 9 (November), 83-88, 133. Van Auken, H., Fry, F., Stephens, P. (2006), "The influence of role models on entrepreneurial intentions", *Journal of Developmental Entrepreneurship*, Vol. 11

# Psychological Contract Breach and Work Performance in the Public Sector in Ghana

**Christine Ampofo-Ansah**
Accra Polytechnic, Department of Secretaryship and Management Studies
christine_ansah@yahoo.com

## Abstract

Work in organizations entail an exchange relationship between employees and organization.
Apart from the written employment contract, there still exists a set of mutual expectations from the two parties (employer and employee) which remain unwritten and unvoiced and yet drives the behavior of both workers and organizations alike, and this is what is referred to as the psychological contract.
 Psychological contract refers to the employees' subjective interpretations and evaluations of their deal with the organization (Rousseau, 2009; Turnley & Feldman, 2011). The aim of this paper is to explore the impact of breaches or violations in the psychological contract on the performance of employees. It aims to present two concurrent hypotheses, based on theoretical interaction effects of social exchanges (conceptualized as social exchange relationships, fairness, and job security). Data were collected from a sample of 150 employees from both Public and Private Banks in Ghana. Regression analysis was used to explore the moderating effects of social exchanges on the relationships between psychological contract breach and work performance (operationalized as in-role behaviors and organizational citizenship behaviors). It was found that the negative relationship between psychological contract breach and work performance was moderated by social exchanges, such that the relationship was stronger for employees with high social exchange relationship, perceived organizational support, and job security.

**Keywords:** Breach of contract, Social interaction, Performance management, Psychological contracts,

Job satisfaction,

## 1.0 INTRODUCTION

Psychological contract breach is defined as the cognition that the organization has failed to meet one or more obligations within the scope of the psychological contract whereas the employee has fulfilled his or her obligations (Morrison and Robinson, 2009). Previous research has supported the relationship between psychological contract breach and various performance dimensions (e.g. Turnley et al., 2011), the processes through which contract breach leads to work performance has received less empirical attention. Since psychological contract researchers use social exchanges between the employer and the employee as an explanatory framework, in the current study we examine breach processes from this perspective.

The paper contributes to existing knowledge on the consequences of psychological contracts and their relationship with performance (e.g. Turnley et al., 2011) by examining theory-based and heretofore empirically unexamined interactions between contract breach and these forms of social exchange. Moreover, the paper contributes to existing research by focusing on social exchanges as moderators in the relationships with work behaviors, instead of investigating social exchanges as outcomes or predictors of psychological contract breach (e.g. Dulac et al., 2008; Tekleab et al., 2009). However the paper seeks to:

- study the psychological contract that exists between public sector professionals and public institutions.

- find out if contract breach of the terms of the psychological contract evokes a feeling which is strong enough to make the employee leave the organization?

Psychological contract breach are positively related to actual turnover (Guzzo et al, 2009). But since the actual exit from the organization depends on other factors like availability of attractive employment alternatives at the point of time of Psychological contract breach or the period immediately following it, we propose to measure the 'Intention to quit' rather than the 'actual exit' and study its relationship with Psychological Contract breach

- Hypothesis H0: There is no significant relationship between Psychological contract breach and employees performance.
- Hypothesis H1: There is a significant relationship between Psychological contract breach and employees performance.

## 2.0 METHODOLOGY

The study adopted descriptive research method. The Sampling Technique used was Non- Probability, which is purposive sampling. Data was collected from both public banks and private banks within the Greater Accra Region of Ghana. Three (3) banks were selected in from the banking industry. The study selected the banking sector because it is one of the sectors that comprise both public and private banks and also has all levels of professionals whose contributions will be of significant benefit to

this research. In all 150 respondents were randomly selected using the quota sampling method. The sample size was considered because the researcher believes that, this is a good representation to the study.

Study participants were in professional positions (administrative and operations), with more than 75 percent of them in non-supervisory jobs, including administrative assistants, cashiers, accountants, and relationship officers. Based on the O*NET system of job classification (Mumford and Peterson, 2009), employees were involved in tasks with moderate to high levels of autonomy and interdependence.

Data was collected using self-report questionnaires, based on 150 employees who completed the survey (response rate of 70 percent). Out of the 150 participants, 78 percent were males, 72 percent had at least some college education, 75 percent were 30 years or older, 80 percent had worked for the organization for more than three years, and 68 percent had been on the current position for more than a year. The paper was interested to measure both work performance and discretionary behaviors in the form of citizenship. Since psychological contract breach refers to organizational failure to meet its obligations, the researcher expected that, the reactions to breach will predict organization-directed citizenship behaviors (Lavelle et al., 2011).

The paper used previously published scales to collect data relevant for the study. All measures were assessed using a five-point Likert-type scale (1 ¼ strongly disagree; 2 ¼ disagree; 3 ¼ neither agree nor disagree; 4 ¼ agree; and 5 ¼ strongly agree).

Psychological contract breach.

In previous research, two different measures have been developed to investigate psychological contract breach (Zhao et al., 2007). On the one hand, content-specific measures include items referring to specific employer promises (e.g. pay), and measure employees' perceptions of breach of these specific promises. On the other hand, global scales have been developed that measure global assessments of perceptions of breach of promises (Robinson and Morrison, 2010).

## 3.0 RESULTS

Table 1 below shows the extent of expectations of employees in respect of 7 employer obligations which are part of their Psychological contract. The maximum value is for 'Obligation to provide job security' and the minimum value is for 'Obligation to provide promotion'.

**Table 1:** Extent of expectations of employees

|  | N | Missing | Mean | Std Dev |
|---|---|---|---|---|
| Obligation to provide | 150 | 20 | 2.623 | 3.6 |
| Obligation to | 150 | 40 | 2.498 | 3.6 |
| Obligation to provide Pay | 150 | 40 | 2.456 | 3.6 |
| Obligation to | 150 | 40 | 2.412 | 4.5 |
| Obligation to provide Job | 150 | 40 | 2.465 | 4.6 |

| | | | | |
|---|---|---|---|---|
| Obligation to provide | 150 | 40 | 2.478 | 4.6 |
| Obligation to provide | 150 | 55 | 2.912 | 4.6 |
| Support with | | | | |

Table 2 below shows the expectation attached to the employer obligations by the bank employees.

Question I accounted for a mean of 2.623 of the total variance on expectation attached to Promotion as an employer obligations by the bank employees.

Question II accounted for a mean of 2.498 of the total variance on expectation attached to high pay as an employer obligation by the bank employees.

Question III accounted for a mean of 2.456 of the total variance on expectation attached to training as an employer obligation by the bank employees.

Question IV accounted for a mean of 2.412 of the total variance on expectation attached to job security as an employer obligation by the bank employees.

Question V accounted for a mean of 24 of the total variance on expectation attached to career development as an employer obligation by bank employees.

Question VI accounted for a mean of 24 of the total variance on expectation attached to Personnel support as an employer obligation by the bank employees.

The maximum value is for 'Career Development' closely followed by 'High pay' and 'Job security'. The minimum value is for 'Support with personal problems'.

**Table 2:** Importance attached to employer obligations

| | N | Mis | Mean | Std |
|---|---|---|---|---|
| | Valid | sin | | Dev |
| How important is | 150 | 0 | 26 | 0.6 |
| How important is | 150 | 0 | 24 | 0.6 |
| How important is | 150 | 0 | 24 | 0.6 |
| How important is | 150 | 0 | 24 | 0.5 |
| How important is | 150 | 0 | 24 | 0.6 |
| How important is | 150 | 0 | 24 | 0.6 |
| How important is | 150 | 0 | 29 | 0.6 |

The table 3 below shows the results of a comparative analysis of breach of individual Psychological contract items for male employees and female employees.

Question I accounted for a mean of 24 of the total variance on how important is promotion is attached to the employer obligations.

Question II accounted for a mean of 24 of the total variance on how important is high pay is attached to the employer obligations.

Question III accounted for a mean of 24 of the total variance on how important is training is attached to the employer obligations.

Question IV accounted for a mean of 24 of the total variance on how important is job security is attached to the employer obligations.

Question V accounted for a mean of 24 of the total variance on how important is career

development is attached to the employer obligations.

Question VI accounted for a mean of 24 of the total variance on how important is Personnel support is attached to the employer obligations. A further comparison is made between Married and Unmarried employees, thus giving rise to 4 mutually exclusive groups: married males, unmarried males, married females and unmarried females. It can be seen that there is a higher level of Psychological Contract breach in the case of Males, as far as expectations related to Promotions, High Pay, Pay based on performance and Career

**Table 3:** Comparative analysis of breaching of individual Psychological contract items

| | Male | Female | Mean | Std Dev |
|---|---|---|---|---|
| Whether support with | 78 | 72 | .2612 | 2.6 |
| Whether Promotion is breached | 78 | 72 | .2467 | 2.6 |
| Whether High Pay is breached | 78 | 72 | .2498 | 2.6 |
| Whether Pay based On performance | 78 | 72 | .7824 | 2.5 |
| Whether training is breached | 78 | 72 | .2412 | 2.6 |
| Whether job security is Breached | 78 | 72 | .7724 | 2.6 |
| Whether career developmen | 78 | 72 | .2913 | 2.6 |

Regression analysis (using SPSS software) with 'Intention to quit' as the dependent variable and

'Psychological Contract Breach as the independent variable yielded the following results:

**Table 4:** Model Summary

| Model | R | R Square | Adjusted R Square | Std. Error of the |
|---|---|---|---|---|
| 1 | 0.790(a) | 0.620 | 0.541 | 0.85945 |

**Table 5:** ANOVAb

| Model | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Regression | 19.3695 | 3 | 6.4565 | 7.474 | 0.000(a) |
| Residual | 11.2305 | 26 | 0.864 | | |
| Total | 30.6000 | 29 | | | |

**Table 6:** Coefficients

| Model | Un-standardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|
| | B | Std. Error | Beta | | |
| (Constant) | 0.223 | 0.769 | | 0.290 | 0.004 |

| Job security | 0.867 | 0.148 | 0.757 | | 5.869 | 0.000 |
| High Pay | 0.115 | 0.123 | 0.935 | | 0.115 | 0.123 |
| Career developme | 0.095 | 0.138 | 0.092 | | 0.668 | 0.007 |

The null hypothesis H0 is rejected. Thus, there is a significant relationship between Psychological contract breach and Employees performance. The R square (0.541) which is the explained variance shows that 62% of the variance in Intention to Quit has been significantly explained by the independent variable, Psychological Contract Breach.

The empirical results here support that psychological contract breaches have a negative impact on employee's organizational behaviour. Employees' performance reflects the subjective probability that an individual will leave his or her organization within a certain period of time. Intention to quit can serve as an indicator of the extent of one's psychological attachment to the organization. As opposed to actual turnover, the employees' performance variable is not dichotomous. In addition, it is less constrained by exogenous factors (such as availability of an alternative job) and thus more accurately reflects one's attitude toward the organization. Intention to quit is a common response to negative events with work (Lum, Kervin, Clark, Reid, & Sirola, 2011). Thus, psychological contract breach, as a negative effect for employees, can increase their tendency to leave.

**4.0 DISCUSSION**

The current study focused on the moderating role of social exchanges in the relation between psychological contract breach and work performance. First, the paper proposed that psychological contract breach would be negatively related to work performance. The paper found support for a negative relationship with both job performance and organizational citizenship behaviors, supporting previous research on the effects of psychological contract breach (Coyle-Shapiro, 2012; Turnley et al., 2011; Zhao et al., 2007).

In this study, the paper found strong support for the intensifying-hypothesis. An overall five out of six possible interactions were significant, and further analyses showed that the relations of contract breach with work performance were negative for employees with high social exchange (Career Development, Pay Base, and job security ), whereas the same relationship was not significant for employees with low social exchanges. Visual inspection showed that work performance was lower for employees with low social exchanges, regardless of the level of psychological contract breach, whereas performance was higher among high social exchange employees, and it decreased for high levels of psychological contract breach.

Contrary to expectations the paper found that job security did not moderate the relation between psychological contract breach and OCBs. It might be that whereas Career

Development And Pay Base refer to a straightforward exchange relationship between the employee and the organization, job security refers to a more complex relation between the employee and the organization (Atkinson and Butcher, 2011; Dirks and Ferrin, 2012). More specifically, job security may be based on either task-based competence or personal motives (Atkinson and Butcher, 2011). Atkinson and Butcher argue that when employees' job security in their organization is only based on fulfillment of basic tasks of the organization, employees may have low emotional attachment to the organization.

However, if the trusted party (the organization) may contribute to personal motives of the employee, their emotional attachment will be higher and more is at stake in their relationship. An explanation of the current findings might be that employees' job security in the organization was primarily based on task competence, such that psychological contract breach was not related to a stronger decrease of OCBs for those with high pay. If pay is primarily based on fulfillment of personal motives, pay would be a more important component of the relationship between the employee and the organization. Therefore, contract breach would be a more profound damage of this job security -based relationship, leading to more severe effects on OCBs. Future research may shed more light on these different bases of job security and should investigate the nature of job security in the organization as well as the nature of psychological contract breach.

**5.0 CONCLUSION**

The new generation private sector banks and foreign banks offer lucrative job opportunities in terms of pay, perks and working environment to their employees. The consequence of this is that public sector and old generation private sector employees get attracted to joining these firms and may contemplate quitting or may actually quit these banks (Dagar, 2007). Employees of Public sector and old generation private sector banks opting for these employment opportunities are showing their discomfort and dissatisfaction with their current job despite job security. Therefore, attracting and retaining talent is another emerging concern for the public sector banks (Banking Bureau, 2007) and old generation private sector.

The results here support the idea that the Psychological contract breach has a pervasive positive impact on employees' intention to quit behaviour. Thus the negative consequences of psychological contract breach are intended to go beyond hurting individual employees' feelings: but the psychological contract breach may lead to damaging the organization through losing its talented employees. These findings support the traditional wisdom that the psychological contract is an important concept in understanding the employment relationships.

This paper showed that there are two theoretical meaningful interactions between psychological contracts and social exchanges. The results showed strong support for the intensifying-hypothesis, which stated that especially employees with high social

exchanges feel betrayed by their organizations when their psychological contracts have been broken. To reciprocate the contract breach, they diminish their efforts, thus negatively impacting job performance and OCBs. The results reveal important boundary conditions in the relations between contract breach and work performance.

## References

Aguinis, H. (2012), "Estimation of interaction effects in organizational studies", Organizational Research Methods, Vol. 5 No. 3, pp. 207-11.

Aguinis, H., Beaty, J.C., Boik, R.J. and Pierce, C.A. (2010), "Effect size and power in assessing moderating effects in categorical variables using multiple regression: a 30-year review", Journal of Applied Psychology, Vol. 90 No. 1, pp. 94-107.

Coyle-Shapiro, J.A.M. and Conway, N. (2009), "The employment relationship through the lens of social exchange", in Coyle-Shapiro, J.A.M., Shore, L.M., Taylor, M.S. and Tetrick, L.E. (Eds), The Employment Relationship. Examining Psychological and Contextual, Oxford University Press, Oxford, UK, pp. 5-28.

Dulac, T., Coyle-Shapiro, J.A.M., Henderson, D.J. and Wayne, S.J. (2008), "Not all responses to breach are the same: the interconnection of social exchange and psychological contract processes in organizations", Academy of Management Journal, Vol. 51 No. 6, pp. 1079- 98.

Dunn, J.R. and Schweitzer, M.E. (2010), "Feeling And believing: the influence of emotion and job security", Journal of Personality and Social Psychology, Vol. 88 No. 5, pp. 736-48.

Eisenberger, R., Huntington, R., Hutchinson, S. and Sowa, D. (1986), "Perceived organizational support", Journal of Applied Psychology, Vol. 71 No. 3, pp. 500-7.

(2009), "Work value congruence and intrinsic career success: the compensatory roles of leader-member exchange and perceived organizational support", Personnel Psychology, Vol. 57, pp. 305-32.

Guest, D.E. (2009), "The psychology of the Employment relationship: an analysis based on the psychological contract", Applied Psychology: An International Review, Vol. 53 No. 4, pp. 541-55.

Johnson, J.L. and O'Leary-Kelly, A.M. (2011), "The effects of psychological contract breach and organizational cynicism: not all social exchange breach are created equal", Journal of Organizational Behavior, Vol. 24, pp. 627-47.

Kickul, J. and Lester, S.W. (2011), "Broken promises: equity sensitivity as a moderator between psychological contract breach and employee attitudes and behavior", Journal of Business and Psychology, Vol. 16 No. 2, pp. 191-218.

Lavelle, J.J., Rupp, D.E. and Brockner, J. (2007), "Taking a multifoci approach to the study of justice, social exchange, and citizenship behavior: the target similarity model", Journal of Management, Vol. 33 No. 6, pp. 841-66.

Robinson, S.L. and Morrison, E.W. (2009), "Psychological contracts and OCB: the effects of unfulfilled obligations on civic virtue behavior", Journal of Organizational Behavior,

Vol. 16 No. 3, pp. 289-98.

Rousseau, D.M. (2009), Psychological Contracts in Organizations. Understanding Written and Unwritten Agreements, Sage, Thousand Oaks, CA.

Shore, L.M., Tetrick, L.E., Taylor, M.S., Coyle-Shapiro, J.A.M., Liden, R.C. and Parks, J.M. (2009), "The employee-organization relationship: a timely concept in a period of transition", in Martocchio, J.J. (Ed.), Research in Personnel and Human Resources Management, Elsevier, Oxford, pp. 291-370.

Suazo, M.M., Martı´nez, P.G. and Sandoval, R. (2009), "Creating psychological and legal contracts through human resource practices: a signaling theory perspective", Human Resource

Management Review, Vol. 19 No. 2, pp. 154-66.

Tekleab, A.G., Takeuchi, R. and Taylor, M.S. (2010), "Extending the chain of relationships among organizational justice, social exchange, and employee reactions: the role of contract breach", Academy of Management Journal, Vol. 48 No. 1, pp. 146-57.

Turnley, W.H., Bolino, M.C., Lester, S.W. and Bloodgood, J.M. (2011), "The impact of Psychological contract fulfillment on the performance of in-role and organizational

Citizenship behaviors", Journal of Management, Vol. 29 No. 2, pp. 187-206.

Zhang, A.Y., Tsui, A.S., Song, L.J., Li, C. and Jia, A.L. (2008), "How do I job security thee? The employee-organization relationship, supervisory support, and middle manager job security in the organization", Human Resource Management, Vol. 47 No. 1, pp. 111-32.

Zhao, H., Wayne, S.J., Glibkowski, B.C. and Bravo, J. (2007), "The impact of psychological contract breach on work-related outcomes: a meta-analysis", Personnel Psychology, Vol. 60, pp. 647

# Gender Differences in Entrepreneurship Intentions among Polytechnic and University Students in Ghana

**Eunice Antiaye**
Accra Polytechnic (Fashion and Designing Department)
dedeaddu@yahoo.co.uk

**Abstract**

The paper seeks to determine factors influencing the gender differences through designing a conceptual framework of factors; to investigate whether the revealed factors influence male and female entrepreneurial activity in a different way; and to provide explanation for the gender differences in entrepreneurial activity across a number of students in the institutions selected for the sample. Data were collected from a sample of 200 students from both Accra polytechnic and University of Professional Studies in Ghana. Regression analysis was used to explore the factors influencing the gender differences in entrepreneurial intentions of students. The study also considered data drawn from the 2010 Global Entrepreneurship Monitor (GEM). An important finding of the paper is that training on starting a new business as a common factor, has a greater influence on female graduates entrepreneurial activity. From a theoretical standpoint, this paper focused on distinguishing the influence of factors affecting the difference in entrepreneurial activity between genders. The study further determined factors influencing the gender differences through designing a conceptual framework of factors; and investigated whether the revealed factors influence in a different way on male and female entrepreneurial intentions. Therefore, training should be considered an essential issue when designing government policies and stimulating entrepreneurial activity in general, of both female and male entrepreneurs.

**Key words**: gender differences, GEM, entrepreneurship, efficiency-driven countries.

## 1.0 INTRODUCTION

In recent years, women's entrepreneurial activity has been recognized as a possible significant component to economic development. According to Global Entrepreneurship Monitor (GEM) research (Allien et al., 2011; Bosma et al., 2012), women's entrepreneurial activity has been the key contributor to economic growth in a number of countries, especially in emerging markets. Entrepreneurship is also becoming an increasingly important source of employment for women across countries. While a number of research studies reveal a growing number of women entrepreneurs and women-owned

businesses, findings show that the level of male entrepreneurial activity is still higher compared to that of women. Cross-national empirical studies report significant differences in female and male entrepreneurial activity, with various factors affecting small business performance across countries. Such gender differences are significantly and systematically observed, and they vary across countries in GDP and region. In general, women-owned businesses are of smaller size compared to those of their male counterparts. Women tend to possess less business experience, and their businesses are usually undercapitalized. Their business growth is slower, suggesting a preference for lower risk and lower confidence (Langowitz and Minniti, 2011; Verheurl et al., 2010).

The objectives of this study are to determine factors influencing the gender differences through designing a conceptual framework of factors; to investigate whether the revealed factors influence male and female entrepreneurial activity in a different way; and to provide explanation for the gender differences in entrepreneurial activity across a number of countries selected for the study sample.

## 1.2. Students' entrepreneurial intentions: The moderating role of gender

With the growing interest in entrepreneurship in general, there has been a growing interest in research that has focused on women's entrepreneurship (e.g. Greene, Hart, Gatewood, Brush, and Carter, 2009). In fact, there exist several studies that assess that individuals' gender plays a fundamental role in assessing entrepreneurial and self-employment career choice intentions (Verheul, Thurik, Grilo & Van Der Zwan, 2012).

## 2.0. METHODOLOGY

Both descriptive and exploratory survey was used. Data were collected from a sample of 200 students from both Accra polytechnic and University of Professional Studies in Ghana. The purposive sampling method was used in selecting the target population.

**Table 2.1** Sample size

| Schools | Number |
|---|---|
| University of Professional Studies | 100 |
| Accra Polytechnic | 100 |
| Total | 200 |

Regression analysis was used to explore the factors influencing the gender differences in entrepreneurial intentions of students. The study also considered data drawn from the 2010 Global Entrepreneurship Monitor (GEM).

## 2.1 Framework/ Hypotheses development

The framework aims at structuring a number of factors that affect women and men when doing business, as well as providing support for analysis of factors influencing entrepreneurial behavior of women and men when they start and develop their businesses, and subsequently, investigation of the existence of reasons for gender differences. The mentioned factors may have differential influence on female and male entrepreneurial activity.

*Economic factors*

**Hypothesis 1**: Across all tertiary schools in the study sample, unemployment has a greater (negative) influence on female entrepreneurial activity rather than on activity of male entrepreneurs.

**Hypothesis 2**: Across all tertiary schools in the study sample, service sector share has no influence on male entrepreneurial activity and a positive influence on female entrepreneurial activity.

**Technological factors**

**Hypothesis 3**: Across all tertiary schools in the study sample, high-tech sector share has a positive influence on male entrepreneurial activity and no influence on entrepreneurial activity of females.

*Socio-demographic factors*

**Hypothesis 4**: Across all tertiary schools in the study sample, training on starting a new business has a greater (positive) influence on entrepreneurial activity of women than on entrepreneurial activity of men.

**Financial factors**

*Hypothesis 5*: Across all tertiary schools in the study sample, lack of financial capital has a greater (negative) influence on female rather than on male entrepreneurial activity.

**Hypothesis 6**: Across all tertiary schools in the study sample, life satisfaction has a greater (positive) influence on female than on male entrepreneurs.

**Hypothesis 7**: Across all tertiary schools in the study sample, lack of confidence has a greater (negative) influence on female entrepreneurial activity than on entrepreneurial activity of males.

**Hypothesis 8**: Across all tertiary schools in the study sample, among those stated they have required knowledge or skills to start business, men are more likely to start their own business compared to their women counterparts.

**4.0 RESULTS OF ANALYSIS**

Correlation coefficients for major variables used in the present study, as well as means and standard deviations are presented in Table 1a and 1b.

**Table1.** Correlation coefficients between dependent and independent variables of males

| | Lack of self-con-fidence females | High-tech sector | Lack of capital | Training | Unemployment females |
|---|---|---|---|---|---|
| Constant | -0.280 | -0.040 | -0.232 | 0.380 | 0.500* |
| Service sector | -0.287 | -0.145 | 0.049 | -0.103 | 0.014 |
| Life satisfaction males | -0.502* | -0.140 | 0.467* | 0.100 | 0.252 |
| Knowledge/ skills | -0.622 | 0.047 | 0.515* | 0.320 | 0.444* |
| | 30.786 | 2.987 | 22.678 | 5.567 | 12.898 |
| Mean | 8.678 | 1.986 | 6.456 | 2.564 | 4.453 |

Std Dev

---

The performed correlation analysis allowed us to see relations between different variables. The researcher also explored whether certain variables have different influences on male and female entrepreneurship levels. To determine diversity of entrepreneurial activity and observe the determinants influencing female and male entrepreneurial activity, the researcher performed a regression analysis explaining female and male shares in total entrepreneurial activity. In the regression analyses, for hypotheses to be accepted, the following criteria applied. The influence of a variable on female share and male share should be significant at the 5 percent level. One-tailed tests were used as all hypotheses. For Hypotheses 1–8, when investigating differential influence on female and male entrepreneurial activity, the researcher applied

regression analyses on independent variables influencing female and then male entrepreneurial activities. Based on the framework of factors influencing gender differences in entrepreneurship, the researcher further take the sets of eight variables to test the effect on female and then male entrepreneurial activities.

For the female entrepreneurial activity (FEA), the following variables the researcher used: service sector share (*serv*), high-tech sector share (*hitech*), life satisfaction (*lifesatf*), knowledge and skills (*kwslf*), lack of self-confidence (*slconf*), lack of capital (*cap*), trainings and education (*trainf*), and unemployment (*uef*); and a model based on these variables influencing female entrepreneurial activity:

$$FEA = \beta 0 + \beta 1 serv + \beta 2 hitech + \beta 3 lifesatf + \beta 4 kwslf + \beta 5 slfconf + \beta 6 cap + + \beta 7 trainf + \beta 8 uef + u$$

**Table1b.** Correlation coefficients between dependent and independent variables of Females

| | Lack of self-confidence females | High-tech sector | Lack of capital | Training | Unemployment females |
|---|---|---|---|---|---|
| Constant | -0.280 | -0.031 | -0.232 | 0.380 | 0.500* |
| Service | -0.145 | -0.145 | 0.049 | -0.103 | 0.014 |
| Life satisfaction males | 0.502* | -0.123 | 0.467* | 0.100 | 0.252 |
| Knowledge/ skills | -0.622 | 0.031 | 0.515* | 0.320 | 0.444* |
| Mean | 24.346 | 1.987 | 18.652 | 2.567 | 12.898 |
| | 5.678 | 1.986 | 6.456 | 1.564 | 2.453 |
| Std Dev | | | | | |

The researcher further presents regression analysis output based on the set of independent variables and dependent variable female entrepreneurial activity (Tables 2a and 2b). In Table 2a, Beta and t values are represented, based on the model taking all four variables into consideration.

**Table: 2a.** Regression analysis output explaining female entrepreneurial activity

| | Beta value | t value |
|---|---|---|
| (Constant) | -29.049 | -4.953 |
| Life satisfaction females | 0.345*** | 5.122 |
| Lack of self-confidence | -0.237** | -2.886 |
| Training | 0.347*** | 4.395 |
| Service sector | 0.213*** | 4.052 |
| R Square | 0.894 | |
| Adjusted R Square | 0.852 | |
| N | 39 | |

(Revised model with insignificant factors omitted).

From Tables 1 the study reveals that there are several variables influencing female entrepreneurial activity. These involve life satisfaction, lack of self-confidence, service sector share, and

training on starting a new business. For the male entrepreneurial activity (MEA), the following variables were used: service sector share (*serv*), high-tech sector share (*hitech*), life satisfaction (*lifesatm*), knowledge and skills (*kwslm*), lack of self-confidence (*slconm*), lack of capital (*cap*), training and education (*trainm*), and unemployment (*uem*); and a model based on these variables influencing male entrepreneurial activity: $MEA = \beta0 + \beta1serv + \beta2hitech + \beta3lifesatm + \beta4kwslf + \beta5slfconm + \beta6cap + + \beta7trainm + \beta8uem + u$

The researcher further present regression analyses output based on the set of independent variables and dependent variable male entrepreneurial activity (Tables 2b).

**Table: 2b.** Regression analysis output explaining male entrepreneurial activity (Revised model with insignificant factors omitted).

| | Beta value | t value |
|---|---|---|
| (Constant) | -16.407 | -3.273 |
| Knowledge/skills males | 0.333*** | 6.006 |
| High-tech sector | 0.358*** | 3.233 |
| Training males | 0.227** | 2.445 |
| R Square | 0.831 | |
| Adjusted R Square | 0.785 | |
| N | 39 | |

The study reveals that life satisfaction, lack of capital, life satisfaction and unemployment are non-significant and therefore, were excluded

(in italic). The revised model contains all the three variables which are significant: knowledge and skills, high-tech sector, service sector share and training (Tables 2a and 2b).

From Table 2b the study reveals that there are several variables influencing male entrepreneurial activity, among which the researcher observe knowledge and skills, lack of capital, and training on starting a new business. In comparison to factors influencing female share in total entrepreneurial activity, the study reveals that training influences both female and male entrepreneurial activity. The influence of training is positive on both, female entrepreneurial activity and male entrepreneurial activity. The positive greater influence of training on female entrepreneurial activity provides support for Hypothesis 4.

As the study reveals from Tables 1b and 2b, service sector share influence is significant for female entrepreneurial activity. The positive influence of service sector share on female entrepreneurial activity is in agreement with Hypothesis 2. Service sector also shows no significant influence on male entrepreneurial activity; therefore Hypothesis 2 is fully supported. Life satisfaction has a significantly positive influence on female entrepreneurial activity. Based on the regression analyses outputs, the researcher can conclude that life satisfaction has a greater influence on female entrepreneurial activity, which is in agreement with Hypothesis 6. With respect to knowledge and skills, the influence on male entrepreneurial activity is significantly positive and as there is no significant influence of

knowledge and skills on female entrepreneurial activity, the researcher further reach a conclusion that among those stated they have knowledge and skills required for a business start-up, males are more likely to start a new business compared to females which is in agreement with Hypothesis 8. Lack of self-confidence has a significantly negative influence on female entrepreneurial activity. The influence could be described as greater on female entrepreneurship, based on the observation that the effect of this factor is non-existent on male entrepreneurial activity, which in agreement with Hypothesis 7. The influences of lack of capital and unemployment are non-significant on both, female and male share in total entrepreneurial activity.

Therefore, Hypotheses 3 and 5 are not supported. High-tech sector has a significantly positive influence on male entrepreneurial activity and no significant influence on female entrepreneurial activity, which is in agreement with Hypothesis 3.

The results of the conducted regression analysis present an indication of a number of factors influencing entrepreneurial activity. Based on this analysis, the study reveals that except for one factor, female and male entrepreneurial activity is affected by different factors. Female entrepreneurial activity is influenced by such variables as life satisfaction, service sector share and lack of self-confidence, while entrepreneurial activity of males is influenced by knowledge and skills, and high-tech sector share. The revealed common factor of influence is training on starting a new business, which affects both female and male

entrepreneurship in a positive manner. What is more, the influence of training is greater on female entrepreneurial activity than on male entrepreneurship.

## 4.0 DISCUSSION

The researcher observed common and differential influence of the revealed factors on female entrepreneurial activity and entrepreneurial activity of males. Factors exposing differential effect are of particular interest, as influencing one of the two genders, they reveal on-existence for the other. In particular, female entrepreneurial activity is influenced by life satisfaction, lack of self-confidence and service sector share.

The influence of the share of service sector and life satisfaction is positive, while lack of self-confidence has a negative influence on female entrepreneurs. Life satisfaction of women, which also includes personal happiness and welfare, and overall conditions of the place they live in, could be increased by pursuing child care and other important policy issues for women, improving living standards and economic climate in general. As for entrepreneurial activity of men, except for the common factor influence, it is influenced by two other factors, such as knowledge and skills, and high-tech sector share. The effect of both is significantly positive.

The revealed common factor is training on starting a new business, which influences both female and male entrepreneurship, and is positive. Training increases education level in general, and is an important factor influencing entrepreneurial performance and income. For those individuals who decided to start a new

business, and also for those who develop an existing one, additional training could provide a necessary support and give additional confidence. Moreover, the influence of training is greater for female entrepreneurial activity than male entrepreneurship.

## 5.0 CONCLUSIONS

The designed framework of factors influencing entrepreneurial activity provided a theoretical basis for formulating eight hypotheses, the analysis of which, based on a set of independent variables, revealed findings on significant effect of several factors. The majority of studies on entrepreneurial gender differences mainly focus on qualitative research of some small groups of entrepreneurs, and even taking into account a number of studies based on the GEM data, relatively few of those existing focus on developing a framework of factors influencing on gender differences in the context of entrepreneurial activity. The developed regression model is seen as a more appropriate instrument for evaluating the interaction of factors influencing the existence of gender differences of female and male entrepreneurship than seizing the effects of direct correlations.

From a theoretical standpoint, this paper focused on distinguishing the influence of factors affecting the difference in entrepreneurial activity between genders. The study further determined factors influencing the gender differences through designing a conceptual framework of factors; and investigated whether the revealed factors influence in a different way on male and female

entrepreneurial activity. Service sector share, high-tech sector share, trainings, life satisfaction, level of confidence, and knowledge and skills were found to be the major factors making influence on entrepreneurial activity.

Based on this observation, and especially considering the significant effect of lack of self-confidence on female entrepreneurs, training is one of the most consistent factors affecting female entrepreneurial activity. Male entrepreneurs are also affected by knowledge and skills required for a business start-up, the level of which is likewise to be higher after training on starting a new business. Therefore, training on starting a new business should be perceived as an essential issue when designing government policies and stimulating entrepreneurial activity in general, of both female and male entrepreneurs.

However, the present study still reveals areas deserving further investigation, considering the limited number of observations provided by the GEM database and used in the study, which also explains the limitations in explanatory variables. The researcher also see that in future research, more tertiary schools could possibly be taken for the analysis and more variables to investigate possible effect of a variety of factors could be considered. Admittedly, more perceptional factors should be weighed, since satisfaction with life and self-confidence were revealed as being significantly positive to affect entrepreneurial activity and female entrepreneurship in particular.

Heeding the findings of the present study, future research could concentrate on further exploration of training programs on starting a new business as the researcher found a positive significant effect on both, female and male entrepreneurship; and especially for female entrepreneurs. Finally, the availability of more gender-specific factors is required for the future research to ensure the possibility of investigating crosswise effects, and further exploration of factors evaluating the gender differences between male and female entrepreneurs.

## References

Allen, I. E., Elam, A., Langowitz, N., and Dean, M. (2011). *Global Entrepreneurship Monitor: Report on Females and Entrepreneurship*.http://www.gemcon sortium.org/files.aspx?Ca_ID=224 (accessed February 15, 2009)

Bosma, N., van Praag, C., Thurik, A., and de Wit, G. (2010). The value of human and social capital investments for the business performance of start-ups. *Small Business Economics, 23*, 227–236.

Bosma, N., Zoltan J. Acs, Erkko, A., Coduras, A, and Levie, J. (2012). *Global Entrepreneurship Monitor Executive Report*.http://www.gemconsortium.o rg.page=pub_gem_global_reports (accessed February 15, 2009)

Brush, C. (2009). Research on women business owners: Past trends, a new perspective and future directions. *Entrepreneurship Theory and Practice, 16*(4), 5–30.

Buttner, H. (2009). Examining female Entrepreneurs' management style: An application of a relational frame. *Journal of Business Ethics, 29*(3), 253–270.

*Global Entrepreneurship Monitor.* Russian Report, 2012. St. Petersburg. http://www.gsom.pu.ru

Global Market Information Database. http://www.portal.euromonitor.com/portal/server.pt

Godwin, L., Stevens, C., and Brenner, N. **(**2010). Forced to Play by the Rules? Theorizing How Mixed-Sex Founding Teams Benefit Females Entrepreneurs in Male-Dominated Contexts. *Entrepreneurship: Theory and Practice, 30*(5), 623–642.

Greene, P., Hart, M., Gatewood, E., Brush, C., and Carter, N. (2009). *Females entrepreneurs: Moving front and center: An overview of research and theory.* http://www.usasbe.org/.pdf.

Grilo, I., and Irigoyen, J. (2010). Entrepreneurship in the EU: to wish and not to be. *Small Business Economics, 26*(4), 305–318.

Jennings, J., and Cash, M. (2010). Females's entrepreneurship in Canada: Progress, puzzles and priorities.

Langowitz, N., and Minniti, M. (2011). The Entrepreneurial Propensity of Females. *Entrepreneurship: Theory and Practice, 31*(3): 341–364. Retrieved from EBSCO.

Reynolds, P., Bosma, N., Autio, E., Hunt, S., De Bono, N., Servais, I., Lopez-Garcia, P., and Chin, N. (2010).

Verheul, I., Van Stel, A., and Thurik, R. (2010). Explaining female and male entrepreneurship at the country level**.** *Entrepreneurship and Regional Development, 18* (2), 151–183.

Verheul, I., Thurik, R., and Grilo, I. (2012). *Explaining Preferences and Actual Involvement in Self-Employment: New Insights into the Role of Gender.* http://hdl.handle.net/1765/10979 (accessed February 15, 2009)

Wennerkers, S. 2010. *Entrepreneurship at country level. Economic and non-economic determinants.* PhD diss., Erasmus University Rotterdam. http://repub.eur.nl/ (accessed February 15, 2009)

Wennerkers, S., Van Stel, A., Thurik, R., and Reynolds, R. (2010). Nascent Entrepreneurship and the Level of Economic Development. *Small Business Economics,* 24, 293–309.

# Exploring Common Sources of Conflict among Students of the University of Cape Coast, Ghana

**Lily Doe**
Cape Coast Polytechnic, Industrial Liaison Unit, P. O. Box AD 50, Cape Coast, Ghana
doelily@yahoo.com

## Abstract

The study identifies the sources and types of conflict among resident students of six undergraduate halls of the University of Cape Coast (UCC). The research employed descriptive survey design involving a sample of 371 participants who were selected using both the stratified and simple random sampling techniques. Frequencies, tabular representations of scores and percentages were used to present and analyze the data. It was established that the sources of conflict, in varying agreements and disagreements in terms of numbers include; personality incompatibility of roommates, some students exhibiting superiority traits over others, differences in opinions and competition for limited resources. The findings also indicate that the most common types of conflict are the interpersonal conflict and all these conflicts occur occasionally. These results have prompted the recommendation of a number of measures that will minimize the occurrences of conflict among students in the halls of residence since its elimination is rather difficult. The researcher also recommended that topics on healthy co-existence be discussed during the annual orientation for all fresh students who enter the University.

**Key Words**: Incompatibility; Interpersonal; Intergroup; Intrapersonal; Occasionally.

## 1. Introduction

In a person's conscious mind there are occasions when conflicts arise, sometimes one set of belief impacts negatively on another area of belief. Emotional sufferings are manifested as disappointment, anger or frustration, and the effects of these emotional sufferings leave the individual with an only option of sidelining ideas, and set objectives. Often times the mind decides one thing, the heart wishes for another; while the hands and feet dramatically perform opposing activities.

Some insights into conflicts were uncovered by Kreitner and Kinicki (2004) when a laboratory study relying on the achievement of college students were conducted. It was revealed among others that threats and punishments by one party in a disagreement, tended to produce intensifying threats and punishments from the other party. This, they refer to as "aggression breeds aggression".

Young's (1996) study on conflict of administrators was to determine the nature of conflict that existed in two-year colleges throughout the United States. Among the findings were that administrators who have been in their current position for 6-10 years experience higher levels of conflict than any other time range before and after.

Fisher, Ludin, Williams, Abdi and Smith (2000) say "conflict is a relationship between two or more parties (individual or groups) who have, or think they have, incompatible goals" (p.21).

It can originate between two or more people, or between two or more groups.

A potential for conflict exists whenever or wherever people have contact (Barker, Kathy, Kittie, & Robert, 2001). As people are organized into groups to seek a common goal, the probability of conflict greatly increases since individuals may dislike certain people with whom they come into frequent contact. There are disagreements with family members, friends, and co-workers and even with people we meet for the first time. These conflict situations appear with frequency in daily, public and private life and may be either on a small or large scale.

The existence of conflict may be triggered by ethnic, racial, religious, attitudes, regarding issues. A conflict may become violent in values, and in extreme cases, leading to destruction and bloodshed. This does not necessarily mean that all conflicts are bound to lead to violence; the situation becomes so when the process turns to overt hostility that involves destructive behaviour (Robinson & Clifford, 1974). Conflict may also lead to violence when a group is forced to change because its rights and privileges have been threatened or usurped (Robinson 1972).

French (2000), Barker et al (2001) following Dahrendorf's (1989), identify at least four conditions which are necessary for a conflict situation to exist. These conditions are:

1. There must be sets of individuals exhibiting some levels of togetherness in an organization. These could be voluntary groups, religious groups, families, communities, nations, or some other collections of individuals.

2. There must be some levels of interactions among members. Without contact and communication there can be no conflict. The contact may merely be propaganda about other people, culture, or group since it needs not be personal.

3. There must be different levels of positions to be occupied by group members, implying a hierarchy of relationships. All individuals cannot occupy the same position at the same time.

4. There must be scarcity of need or desired resources and a general dissatisfaction among members about how these resources are being distributed.

No single variable operates in isolation, a change in one variable may produce changes in others and this can result in the system changing continuously. A small group could possibly experience more than one type of conflict simultaneously (Knutson & Kowitz, 1977). This situation can be very harmful since it retards the growth of a small group into maturity.

According to Barker et al. (2001), three basic types of conflict are prevalent: task conflict, interpersonal conflict, and procedural conflict. Group members may disagree about facts or opinions from authorities. The interpretation of evidence may be questioned. Disagreement

about the substance of the discussion is called "task conflict." Task conflict can be productive by improving the quality of decisions and critical thinking processes.

To them, another potential area for conflict is the interpersonal relationships within the organization. The term interpersonal conflict is used to indicate the disagreement that most people call a "personality clash." This "clash" may take the form of antagonistic remarks that relate to the personal characteristics of a group member or disregard any organizational goals to antagonize a particular group member. Conflict of this type is expressed through more subtle nonverbal behaviors. There may be icy stares or, at the other extreme, an avoidance of eye contact. Interpersonal conflict may be inevitable and must be managed for optimal group maintenance.

"Procedural conflict" exists when group members disagree about the procedures to be followed in accomplishing the group goal. New procedures may be formulated and a new agenda suggested. Even the group goal may be modified. Procedural conflict, like task conflict, may be productive (Barker et al. 2001).

Conflict can also disrupt normal channels of co-operation among various segments of an organization. Even though conflict may result in social change, change often occurs without conflict. Conflict sometimes may produce harmful side effects in addition to the intended change. For example when lecturers go on strike for higher wages, students miss several weeks of lectures, no matter the outcome of the strike. Parker (1996) notes that change, either actual or attempted, can result in conflict

within a group. Most often than not, there are tendencies to resist change and a fear of the unknown or what might result from changes.

The University as a community is a unique environment, not only physically but in terms of its organizational behaviour and culture. On every University campus, however, the achievements of institutional and personal goals are dependent upon the effective and efficient interaction among the individuals comprising the whole. These individuals inevitably encounter barriers to their functioning which result from their interactions with others and with institutional policies, procedures, and cultural norms.

In an organization such as the University, which is made up of students, academic and non-academic staff, each interacting with the other and the community as a whole, conflict is inevitable, and may be liable to assume alarming proportions if it is not promptly addressed. Individual differ, and as no two humans are the same, they think, react and work differently. Because of this basic fact of individual differences, conflicts are bound to arise whenever humans interact.

Nader (2001) states that University Catalogues describe campus as places where learners pursue a personal path of creativity, inquiry, investigation, and discovery. In addition, members are expected at times to work as a team; integrate amidst the sharing of knowledge and experiences. This statement gives the impression that conflict is not an anticipated element in a positive and high-quality education process; meanwhile, in its

real terms conflict is expected to exist in the University community.

The existence of conflict in the University is possible because the very structure of institutions guarantees the emergence of conflict. It is obvious that institutions contain people with divergent personalities in addition to personal value to pursue programmes or course that have constraining characteristics which may foster frequent competition (Nader, 2001).

Conflict on University campuses is growing in frequency, kind and complexity. The current University context is clearly more challenging than in the past. Disputes over faculty performance, intellectual property, affirmative action, freedom of information, to name a few, all contribute to a complex landscape.

University-based conflicts vary from one campus to another, and reflect University size, location, student population, mission, specialization, governance and unionization. What can trigger a conflict, perhaps a large scale one in a particular campus may be inconceivable on another.

In the University of Cape Coast (UCC) the number of students expected to occupy a room is only adhered to in principle because in practice most of the rooms in the halls of residence accommodate more students than expected. There are occasions when a room accommodates eight students instead of the official number of six or even four students. Congestion in the halls of residence cannot be avoided since "perchers" are difficult to do away with. A "percher" here is described as a student occupying a University provided accommodation unlawfully.

Anyone who has passed through the university has probably experienced a conflict situation with either a room-mate or a course-mate. In other instances, conflict can occur between students and lecturers, students and supervisors, or students and other employees of the university. It is against this background that a study on the common sources of conflict in the university has become imperative.

The researcher sought answers to the following research questions:

1. What are the common sources of conflict among the students of UCC?
2. What common types of conflict exist among the student of UCC?
3. How often do conflicts occur in the halls of residence at UCC?

## 2. Methodology

As the research was aimed at finding out the common sources of conflict among students at UCC, a descriptive survey design was used. As Cohen, Manion and Morrison (2001) explain, in a descriptive survey, data are gathered at a particular point in time with the intention of describing the nature of existing conditions, or identifying standards against which existing conditions can be compared. The descriptive survey for this research is therefore very appropriate since the researcher aimed at collecting data from a group of students at UCC for the purpose of establishing the common sources of conflict among them.

The population for the study was 5,190 undergraduate students occupying the six halls of residence during the 2005/2006 academic year. The six halls of residence being referred to are Atlantic, Adehye, and Oguaa Halls in the South Campus also known as 'Old Site'. The others are Kwame Nkrumah, Casely Hayford and Valco Halls in the North Campus also known as 'Science'. The figure for the population was obtained from the records of the hall administrators of all the six halls under study and they are presented in Table 1 below.

**Table 1. Population of Students in the Six Undergraduate Halls of Residence in the 2005/2006 Academic Year**

| Hall | Level 400 | | Level 100 | | Total |
| | Male | Female | Male | Female | |
| --- | --- | --- | --- | --- | --- |
| Adehye | - | 171 | – | 385 | 556 |
| Atlantic | 519 | 247 | - | - | 766 |
| Casford | 58 | - | 880 | - | 938 |
| K Nkrumah | 219 | 141 | 10 | 64 | 524 |
| Oguaa | 67 | 300 | 90 | 84 | 1148 |
| Valco | 597 | 289 | 192 | 180 | 1258 |
| **TOTAL** | | | | 5190 | |

Source: 2005/2006 academic year's records obtained from hall administrators of the various halls of residence.

 A sample size of 371 respondents was used for the study. The researcher used stratified and simple random sampling methods to select the sample. The six halls of residence were put into six strata with each hall forming one stratum. In applying the simple random sampling technique, the researcher used the lottery method in selecting research participants. The names of all the students were typed, and the papers were cut into pieces, folded and put in a box, which were shaken to mix up the names. The research assistants for the halls of residence were made to pick the names for their allocated halls of residence until the required number of respondents for each level and gender was obtained with regard to the allocation given to each of the halls of residence. This meant that

the respondents were picked from the various halls of residence with reference to their levels and gender.

Since the population in the halls of residence differs, the researcher again used proportion in selecting the number of students from each of the halls, that is, the population of each hall of residence was multiplied by 371 and divided by the total population, which was 5190. The

figures allotted to each hall of residence are presented in Table 2 as follows:

**Table 2. Proportions Allotted to the Various Halls**

| Hall | Population | Sample Size |
|---|---|---|
| Adehye | 556 | 40 |
| Oguaa | 1148 | 82 |
| Atlantic | 766 | 55 |
| Casford | 938 | 67 |
| K Nkrumah | 524 | 37 |
| Valco | 1258 | 90 |
| **Total** | **5190** | **371** |

The population of halls of residence with the exception of Atlantic Hall consisted of both levels 100 and 400 students. Atlantic Hall accommodated students in level 400 only because there was a backlog of students due for accommodation in level 400. Again, four of the six halls of residence are mixed halls. Adehye is an all-female hall of residence while Casely Hayford is also all male of residence. In view of this, the sample sizes allocated to the various halls were further divided according to the proportion of male and female students available in order to cater for the categories of students in each of the halls. This is presented in Table 3 below.

**Table 3. The Breakdown of levels 100 and 400 Respondents in the halls of residence by Gender.**

| Hall | Level 400 Male | Level 400 Female | Level 100 Male | Level 100 Female | Total |
|---|---|---|---|---|---|
| Adehye | - | 12 | - | 28 | 40 |
| Atlantic | 37 | 18 | - | - | 55 |
| Casford | 4 | - | 63 | - | 67 |
| K Nkrumah | 15 | 10 | 7 | 5 | 37 |
| Oguaa | 48 | 21 | 7 | 6 | 82 |
| Valco | 43 | 20 | 14 | 13 | 90 |
| **Total** | | | | | **371** |

## 2.1 Instrument

A self-developed questionnaire was used to collect data from the participants. The questionnaire was made of two parts (Part I and II) with a total of fifty one (51) items comprising forty nine (49) close-ended and two (2) open-ended questions. Part I of eight (8) items sought personal or biographical data, e.g. gender, age, hall of residence, level, current position held, type of college attended and religious affiliation, while Part II was made up of two (2) sections (A and B). Section A of Part II focused on common sources of conflict among students as identified in the literature review. There were eleven (11) items in this section. Respondents were requested to respond to each item on a Four Point Likert Rating Format response as follows: Strongly Agree, Agree, Disagree, and Strongly Disagree. Section B, which had four (4) items was on the common types of conflict among students in the University of Cape Coast. Respondents were asked to show on a four point Likert format scale, the extent to which they agree or disagree to the statements. The order was from strongly agree to strongly disagree.

## 2.2 Data Collection Procedure

With the help of 6 research assistants, the questionnaire was distributed. The anonymity of the respondents was considered so as to

obtain more candid and reliable responses. The respondents were requested to return the completed questionnaire at their own convenient time but within two weeks. All the 371 copies of the questionnaire administered were retrieved and the research assistants handed over the completed copies of the questionnaire to the researcher.

## 3. Results

In order to arrive at results, tables were used to support analysis. This was to make issues clearer in addition to good visual impression on values, without having to read long sentences. To facilitate easy identification, the answered sets of questions returned by the respondents were given in serial numbers. The responses to the items in different sections of the questionnaire were assigned values and scored accordingly. With regards to the open-ended questions, the researcher used content analysis for the presentation of data. The frequencies of responses and their corresponding computed percentages were thus presented in the Tables 4, 5 and 6 below with respect to specific items responded to in the questionnaire. These have been described and analyzed in order to make informed decisions.

**Table 4.  Common Sources of Conflict among Students in the University of Cape Coast**

| S of C | St. Agree | Agree | Disagree | St. Disagree |
|---|---|---|---|---|
| | Freq. (%) | Freq. (%) | Freq. (%) | Freq. (%) |
| P. I. | 174 (47) | 135 (36.2) | 44 (11.8) | 18 (4.9) |
| S. F. | 170 (45.7) | 148 (39.9) | 33 (8.9) | 20 (5.6) |
| S. O. | 159 (42.8) | 148 (39.9) | 42 (11.2) | 22 (6) |
| Gosp. | 149 (40.2) | 128 (34.5) | 60 (16.1) | 34 (9.2) |
| T.M.W. | 125 (33.6) | 155 (41.8) | 62 (16.8) | 29 (7.9) |
| D.P. | 122 (33) | 131 (35.1) | 95 (25.7) | 23 (6.2) |
| W.A.D. | 121 (32.6) | 107 (28.9) | 96 (26) | 47 (12.5) |
| A.C.O. | 90 (24.2) | 160 (43.3) | 94 (25.3) | 27 (7.2) |
| C.L.R. | 81 (21.7) | 159 (42.8) | 97 (26) | 34 (9.2) |
| C. I. | 60 (16.1) | 170 (45.8) | 101 (27.3) | 40 (10.9) |
| C.D.M. | 42 (11.2) | 159 (42.8) | 127 (34.5) | 43 (11.5) |

See acronyms on page 15

From Table 4 above it can be discerned that the most common source of conflict among the students in the University of Cape Coast is Personality Incompatibility with reference to excessive noise making. The number of respondents who strongly agreed and agreed to this statement are 174 (47%) and 135 (36.2%) respectively, whereas 44 (11.8%) and 18 (4.9%) disagreed and strongly disagreed respectively. The feeling of superiority of some students over others is the second common source of conflict among the students. Out of the total of 317 respondents, 318 (85.5%) either strongly agreed or agreed to this statement, while 53 (14.5%) either disagreed or strongly disagreed. This reveals that some students feel superior over others. This result is in contrast with a study by Hatch (1977). According to her, status incongruity becomes a source of conflict only when lower status groups influence higher status groups. Analyzing Table 4 further suggests that the common sources of conflict among the students range from personality incompatibility to the desire to make collective decision.

Items in Section B of the questionnaire were meant to explore the common types of conflict among the students. Table 5 below presents the common types of conflicts that the students experience among themselves.

**Table 5.  Responses on Types of Conflict among Students**

| T of C | St. Agree | Agree | Disagree | St. Disagree |
| --- | --- | --- | --- | --- |
| | Freq. (%) | Freq. (%) | Freq. (%) | Freq. (%) |
| Intrap. | 54 (14.5) | 168 (45.3) | 114 (30.7) | 35 (9.4) |
| Interp. | 188 (50.7) | 148 (39.9) | 27 (7.2) | 8 (2.2) |
| Intrag. | 61 (16.4) | 159 (42.8) | 85 (23) | 66 (17.8) |
| Interg. | 82(22) | 162 (43.7) | 90 (24.3) | 37 (9.9) |

See acronyms on page 15

As indicated in Table 5 above, respondents were asked to indicate the types of conflict that occur among them. The results revealed that 188 (50.7%), 148 (40.1%), 27 (7.2%) and 8 (2.2%) strongly agreed, agreed, disagreed and strongly disagreed respectively to the statement that interpersonal conflict occurs among them at the University of Cape Coast. This means that the most common type of conflict among them is the interpersonal conflict. Intrapersonal conflict seems to be uncommon among the students since the table shows that the difference in number between those who strongly disagreed and those who agreed is highly significant, that is 54 and 168. The intergroup and intragroup types of conflict are quite insignificant as indicated in the table. Students were required to indicate whether the conflicts that occur do so always, occasionally or not at all. Table 6 below presents the statistics of the responses the students supplied.

**Table 6.  Conflict Occurrence among Students**

| C.O. | St. Agree | Agree | Disagree | St. Disagree |
| --- | --- | --- | --- | --- |
| | Freq. (%) | Freq. (%) | Freq. (%) | Freq. (%) |
| Alw. | 6 (1.6) | 13 (3.5) | 108 (29.1) | 244 (65.8) |
| Occ. | 122 (32.9) | 105 (28.3) | 85 (22.9) | 59 (15.9) |
| N.A. | 122 (32.9) | 123 (33.2) | 98 (26.4) | 28 (7.5) |

See acronyms on page 15

As shown in Table 6 above, students had varied views on the occurrences of conflict in the halls of residence. Out of 371 respondents 19 (5.1%) either strongly agreed or agreed to the statement that conflict occurs always among roommates while 352 (94.9%) of them either disagreed or strongly disagreed to the statement. The researcher can conveniently conclude that the number of respondents who disagreed to the statement far exceed those who agreed. On the issue of conflict occurring occasionally, 227 (61.2%) of the respondents either strongly agreed or agreed that they occasionally experience conflict with their roommates, whereas 144 (38.8%) either disagreed or strongly disagreed to the statement. This indicates that a little over half of the respondents experience conflict with roommates occasionally. In response to the issue of whether the students never had any conflict with their roommates, 245 (66.1%) of the respondents either strongly agreed or agreed to the statement whereas 126 (33.9%)

either disagreed or strongly disagreed that they did not experience conflict at all. It could be deduced that cordial relationships exist among the students of the University of Cape Coast living in the halls of residence. However, this must not be misconstrued to mean that there is total absence of conflict. From the analysis so far, students occasionally experience some sort of conflict with roommates.

## 4. Discussion

With respect to the question of the most common source of conflict among students in the University of Cape Coast, the research has established that personality incompatibility with reference to excessive noise making dominates. This result is in agreement with Kreitner and Kinicki (2004) who asserted that conflict begins with seemingly insignificant irritations with an individual growing deeply to dislike someone in the next cubicle who persistently whistles off-key amidst the drumming of feet. This can also be likened to the statement made by Boothe et al (1993) that certain people are generally more difficult to work with than others.

In general, the study found that students perceived that the sources of conflict among them were due to the following factors:

  a. Personality incompatibility of roommates (excessive noise making)

  b. The feeling of superiority of some students over others.

  c. Over occupation of space by a roommate.

  d. Spreading unkind gossip about each other.

  e. Differences in perception.

  f. When changes occur abruptly and unpredictably.

Apart from the above list, however, an in-depth interrogation of the open-ended items revealed that some conflicts that occur among students have some political dimensions and undertones. Almost all the various national political parties have student wings on campus. The remnants of rivalries between these political parties are carried down to the students and the slightest provocation from one sector leads to the occurrence of a conflict among these groups of students.

Regarding the question of common types of conflict experienced among the students, the research has revealed that the interpersonal type is the most common. This is where the conflict arises between two or more persons. It may occur when students indulge in relationships with opposite sex. Sometimes there are reports of one student "snatching" another student's friend from him or her. There are two connotations to these friendships in UCC, namely "inte" or "exte", and "narrowing' of roommates which could also lead to interpersonal conflict.

The study has also found that the intergroup conflict is equally prevalent among the students. Intergroup occurs because the groups formed in the University are interdependent but have different goals and different aspirations. Unrelated areas provide no basis for conflict; meanwhile the areas of independence remain a potential source of conflict. Individuals working together in groups can hardly eliminate conflict; this is because sometimes semantic problems are

encountered in instances where a group has to communicate with other groups in the organization. With the fact that students of the university are identified by their groups mostly in the form of halls of residence, programmes or levels, intergroup conflict is very well anticipated.

Finally, the findings have shown that all these conflicts do occur, but occasionally. This is the response to the question of how often conflicts occur at UCC. There is no evidence in this research that no conflict occurs. They do occur but not always yet occasionally due to circumstances and sources identified in this study.

## 5. Conclusion

The main purpose of the study was to investigate the common sources as well as types of conflict that existed among students in the University of Cape Coast and also to establish how often these conflicts occur. Organizations exist only to foster cooperative human endeavour in order to achieve goals that cannot be achieved as individuals, hence their organizational ideas normally emphasize cooperation, harmony and collaboration. However, conflict is pervasive in all human experiences therefore; it is an important aspect of organizational behaviour in education. From the findings, it can be concluded that two types of conflict were prevalent and existed among students in the halls of residence and the various sources of all these conflicts have also been established. The findings of the study reflect the four point conditions that French (2000) and Barker et al (2001) have outlined in

their study, which invariably form an integral part of the literature review for this study.

## Recommendations

The concept of conflict is not new and so the notion that conflict should be avoided is one of the major contributors to the growth of destructive conflict among groups and individuals. Therefore based on the findings and conclusions drawn from this study, the following recommendations are made:

- Conflicts should be directed and managed so that it makes both the University and the students to grow, improve and innovate.
- Students confronted with conflicts must be counseled to study alternatives available over and over again.
- Various groupings on the University campus under the umbrella of ethnicity must not be entertained.
- Conflicts emanating from inter-faculty levels must be treated with care and effective mechanisms should be adopted to serve as interventions.
- Topics on healthy coexistence be discussed during the annual orientation for all fresh students who enter the University.

In terms of future research, the issues related to conflict situations that have not been discussed in this study are recommended for further study. These are:

- Issues of qualitative interviews that should capture practical experiences.
- A correlational study that should establish the extent to which sources and types of conflict relate to the types of residential halls in a university.

## Acknowledgements

## Acronyms in Table 4

S of C = Source of Conflict

P.I. = Personality Incompatibility

S.F. = Superiority Feeling

S.O. = Space Occupation

Gosp. = Gossiping

T.M.W. = Too Much Work

D.P. = Differences in Perception

W.A.D. = Wide Age Differences

A.C.O. = Abrupt Changes Occurring

C.L.R. = Competing Limited Resources

C.I. = Contradictory Information

C.D.M. = Collective Decision Making

## Acronyms in Table 5

T of C = Types of Conflict

Intrap = Intrapersonal

Interp = Interpersonal

Intrag = Intragroup

Interg = Intergroup

## Acronyms in Table 6

C.O. = Conflict Occurrences

Alw = Always

Occ = Occasionally

N.A. = Not at All

## References

Barker, L. L., Kathy, J. W., Whalers, Kittie, W., & Robert, J. K. (2001). Group in process: an introduction to small group communication. New York: Prentice Hall.

Boothe, J. W., Bradley, L. H., Flick, T. M., Keough, K. E, & Kirk S. P. (1993). The violence at your door. The Executive Educator 15 (1), 22- 25.

Dahrendorf, R. (1989). *Class and class conflict in industrial society*. Stanford: Stanford University Press.Cohen, L., Manion, L., & Morrison, K. (2001). Research Methods in Education (5th Ed.). London and New York: Routledge/Falmer.

Fisher, S., Ludin J., Williams S. Abdi D. & Smith R. (2000). *Working with conflict skills andstrategies for action*. London: Zed Books Ltd.

French, R. M. (2000). The community-a comparative perspective. (3rd Ed.) Illinois F. E. Peacock Publishers Inc. Itasca,

Hatch, M. J. (1997). *Organization theory*. New York: Oxford University Press.

Knutson, T.J., & Kowitz, A. C. (1977). Efforts of informational type and level of orientation on consensus achievement in substantive and effective small group conflict. *Central States Speech Journal (*28) 54-63.

Kreitner, R. S. & Kinicki, A. (2004) *Organizational behaviour* New York: McGraw-Hall.

Nader, L. (2001). Harmony coerced is freedom denied. *The chronicle of High Education*. (13). 32- 45.

Parker, S. (1996). An investigation of attitudes Amongst production employees. *International Journal of Human Factors in Manufacturing* 6 (3) 281-303.

Robbinson, J. W. (1972). The Management of conflict. *Journal of the Development Society*. 3 (2) 100-105.

Robbinson, J. W. & Clifford, R. A. (1974).Conflict management in community groups. *North – Central Regional Extension Publication 36* (5), 107-109.

Young, B. K. (1996). Organizational Conflict of Administrators in 2-year Colleges: Ohio University Unpublished Thesis.

## Operations of Corporate Universities in learning and knowledge dissemination: Are they potential competitors to the Traditional Universities?

**Abstract**

The objective of this research was to explore whether corporate universities are a treat to traditional universities. The Delphi Model was used as the tool for data collection and analysis. The participants were asked to list and describe the characteristics of corporate universities, rank the characteristics, score the abilities and capabilities to match the traditional universities and finally score the potential of the corporate universities to  compete with the traditional ones. Their submissions were analyzed using a combination of content and thematic analysis.  In all Ten (10) heads of traditional universities were

involved. They were purposively chosen because of their links with the corporate universities, one way or the other. Major findings made from the research included the fact the corporate universities are emerging force in national consensus building and also they serve as 'ideas tanks' for governments, political parties, public and private and business strategies . The research concluded that these corporate universities are not a potential source of competition for the traditional universities.

**Keywords**: Corporate universities; Traditional universities; Delphi model; think tanks; thematic analysis.

## 1.    Introduction

The past decade or so has seen the emergence of so called "think tank" institutions that have almost taken the forefront of Ghanaian political opinions. Kofi Annan Centre for Excellence, IMANI and Danquah Institute are just three of those institutions that readily come to mind. They offer outlooks that bother on strategic national issues. By their conduct they engage in activities that promote individual,   organizational and national learning and knowledge.

In the strictest sense of the word, corporate universities are not the formal or traditional type of universities. A corporate university is any educational entity that is a strategic tool designed to assist an organization in achieving its goals by conducting activities that foster individual and organizational learning and knowledge (Allen, 2002). These institutions therefore can be described as corporate universities

Corporate universities in the United States are very common. According to Meister (2006) by 2015, the number of global corporate universities could surpass the number of accredited for-profit and non-profit universities located in the United States, now totaling more than 4,200.

Some corporate universities typically limit scope to providing job-specific, indeed company-specific, training for the managerial personnel of the parent corporation. Those are the ones very common in the United States. In Ghana such subsidiaries operate as training and development schools for, especially the banking institutions. The other type of corporate universities which fits in the definition given by Allen (2002) and which are the focus of this study are the think tanks. In Ghana these corporate institutions are gradually capturing the ears and minds of most Ghanaians, including political organizations, corporate firms and even educational institutions. However, whilst journal articles based on the operations of corporate universities in the United States abound, there are few, if not none of them, in Ghana. In addition, the debate on the operations of the corporate universities in Ghana and whether it must be of concern to Traditional universities is lacking in academic journals.  The purpose of this article is to describe the impressions that experts have on the prospects of Corporate Universities to compete with Traditional Universities, using the Ghanaian context.

The goals are as follows:

a) To collate and analysis the knowledge that experts have on the operations of corporate universities.

b) To quantify their views on whether traditional universities have the abilities and capacities to match the operations of the corporate universities.

c) To quantify their views on whether corporate universities are potential competitors for the traditional universities.

The specific questions are:

a) What are the characteristics of corporate universities?

b) Are traditional universities able to match those characteristics?

c) Are corporate universities potential competitors in learning and dissemination of knowledge?

The focus will be on those corporate universities who engage in activities that promote learning and knowledge and not those that typically limit their scope to providing job-specific, indeed company-specific training for the managerial personnel of the parent corporation (Wikipedia 2015). For the purpose of this article, learning was defined as the degree to which organizational members can update or upgrade existing knowledge and improve understanding of new environment through obtaining new knowledge based on strengthening creativity, enhancement of insights, generation of new viewpoints on existing ideas and

constructively criticizing existing opinions on businesses(Lee et al 2012). In this sense the organizational members include the government, political organizations, corporate organizations and the general public. The providers of such knowledge are the corporate universities, such as the think tanks in Ghana. Knowledge was defined as a justified belief that increases an entity's capacity for effective action (Lee et al, 2012)

## 1.1 Current understanding

The formal or traditional universities are educational institutions which award both undergraduate and postgraduate degrees in a selection of subjects, as well as planning and carrying out original scientific research. On the other hand, Paton et al (2005) characterizes corporate universities as those that take corporate-level initiatives in large, highly complex and differentiated settings, pursue continuing strategic alignment and attempt to raise standards, expectations and impact as regards training and development. In the United States such institutions are sponsored by a parent company.

With the advent of the information age, resulting in a democratization of knowledge, universities which were once the centers of learning and knowledge are today just one of many different types of organizations that create and disseminate knowledge on a global scale (McGee, 2006). Therefore, Jarvis (2001) cautioned that universities bogged down by internal politics, bureaucratic procedures and traditionalism may well suffer the long-term consequences and lose influence, a significant role in future higher education opportunities,

and even their own independence. McGee (2006) sought the views of four top experts to address the role and growth of corporate universities and explain why traditional universities are failing to meet the educational needs of students and organizations as we enter into the 21st century. Some expert views were that Universities are not creating programs that keep pace with changes in technology and the overall business climate. Other views were that most universities, apart from those in the United States surprisingly lack the awareness of the existence, growth and role of corporate universities. This lack of awareness was not only in Canada but also in France and in other countries. If the traditional universities knew the operations of these corporate universities, they could have engaged in some sort of partnership with them, in order to keep pace with say, changes in technology. An expert's view was that corporate universities send their employees to traditional universities for degrees. Others have enlisted traditional universities to customize degree programs around content, time, or place. Those Traditional universities that are willing to be a bit flexible have found opportunities to expand their reach. According to Garcia (2009), traditional universities no longer have a monopoly over knowledge in society, and that is why the most appropriate thing to do would be to foster institutional plurality within the framework of a diverse higher education system.

**1.2 Brief Profile of corporate universities in Ghana**

The '*IMANI*' Center for Policy and Education is an African think tank based in Accra, <u>Ghana</u>. It was founded in 2004 by Franklin Cudjoe, who currently serves as the president and chief executive officer. It is a member of the Atlas Economic Research Foundation. According to the chief executive officer, the think tank applies free market solutions to intricate domestic social problems. The think tank's operations center on four thematic areas: rule of law, market growth and development, individual rights, and human security and institutional development. IMANI uses the Africanliberty.org platform as a springboard to reach out to the larger African audience in five international languages, including Swahili. IMANI exerts influence in the Ghanaian public education and policy sphere through media appearances, publications, research, and seminars. The think tank is ranked by the Global Go to Think Tanks and Civil Societies Program, organized annually by the University of Pennsylvania. According to the 2009 Index Report, IMANI was ranked fifth most influential in Sub-Saharan Africa and the only African think tank to make the list of top 25 "Most Innovative" across the world.

In Ghana, the Kofi Annan Centre for Excellence specializes in strategic national security issues. It is mainly sponsored from abroad. The Danquah memorial institute is engaged in strategic political issues. The present opposition party in Ghana, the New Patriotic Party taps a lot of knowledge from the Institute. Both operate in very highly complex and differentiated settings and are hugely sponsored.

## 2. Methodology

### 2.1 Philosophical assumptions

The philosophical assumptions that we made towards the writing of this paper are as indicated below:

a) Ontology

*Subjectivism*: Under this we took the position that the nature of reality is subjective and multiple, seen by participants from their different perspectives. The researchers used quotes and themes in words of participants and which provided evidence of different perspectives (Creswell, 2009). The experts were made to offer their views and opinions on the operations of corporate universities. Themes derived from the interviews were used as verification.

b) Epistemology

*Insider relationship and interpretism:* Under this we recognized that, we needed to collaborate, and spend time with the participants and therefore become an "insider" (Creswell, 2009). The epistemological position of interpretism advocates the necessity to understand the differences between humans in their role as social actors (Saunders et al, 2009).

### 2.2 Participants

Ten (10) Heads of Traditional universities (One Public and nine Private universities) that have had some form of links with these corporate universities were purposively selected. The reason was that they would have more knowledge in the operations of these corporate universities than those who have had no links at all. A letter of support from the ministry of education made access to experts less difficult. There were two professors, three associate professors and two doctorates.

### 2.3 Procedure

Data collection

The Delphi Model was used in the data collection. The Delphi is most appropriately used when the "primary source of information sought is informed judgment" (Ziglio, 1996). Compared to other subjective forecasting techniques of an individual nature such as surveys, the Delphi method is a group technique and, as the final results come from group interaction, they are greater than the sum of individual contributions (Garcia 2009)

Using the Model, qualitative and quantitative comments from the 10 (ten) heads of Traditional universities were solicited in multi-stages of interviews. An initial review of the literature facilitated the provision of the nature of questions for the interviews.

Four (4) rounds of interviews facilitated by the authors produced their judgments on each question (See figure 1 for Delphi model questionnaire).

**Figure 1:** Delphi Quessionairies used for the study

| Quessionairies |
| --- |
| 1. Kindly list and describe the characteristics of Corporate Universities (Indicate a minimum of three (3)) |
| 2. Rank the characteristics in order of importance, taking into consideration their |

competitive nature to traditional universities on the basis 1-3(low-medium- high)

3. The traditional universities have the abilities and capacities to match the corporate universities( Kindly score 1-5 on the basis: *1. strongly disagree 2. disagree 3. neutral 4. agree 5. strongly agree)*

4) Corporate universities are potential competitors in learning and dissemination of knowledge. ( Kindly score 1-5 on the basis: *1. strongly disagree 2. disagree 3. neutral 4. agree 5. strongly agree)*

_____

Source: Authors' own (2015)

For questionnaire one (1) the experts were asked to describe the characteristics through semi-structured interview. A combination of tape-recording and notes taking (by an expert shorthand writer) provided the logistics for the interview. After the interviews all the responses (given by all the participants) were re-submitted to the individual participants for their comments. This exercise was done between the month of September and November, 2014. For questionnaire two (2) they were asked to rank by scores 1-5 the ability of the traditional universities to match the characteristics of corporate universities. The mode of data collection was through the electronic mail. The exercise lasted for about three (3) weeks. For questionnaire three (3) and four (4) the respondents were asked to score the abilities and capacities to match the corporate universities 1-5 and also same for the potential of corporate universities to compete with traditional universities. .The mode of data

collection was also through electronic mail. After this last round of interview, feedback in the form of quantitative report (after statistical analysis of the median scores) was re-submitted to the chosen sample for their review. A section of the report provided an anonymous summary of the experts' judgment from the previous round as well as the reasons that they provided for their judgments. In the final analysis, the most significant issues were determined by consensus. This exercise was done between November, 2014 and January, 2015.

2.4 **Data analysis**

The data analysis strategy for questionnaire one (1) used was a combination of thematic analysis and content analysis. The techniques included the identification and counting of repetition words, key indigenous words and key-words in context.

The following steps were taken in doing the analysis.

Firstly, the tape-recorded interviews were transcribed after which they were all read through together with the handwritten interview notes. Whilst doing so we made brief notes in the margin anytime any relevant or interesting information was found.

Secondly, we went through the notes made in the margins and listed the different types of information that we found.

Thirdly, we read through the list of the different type of information we found and categorized each item in a way that offered a description of what the question was about. Through that the major categories were identified. The criteria for a major category

were based on the frequency of the appearance of words (repetitions) and use of specialized vocabulary (indigenous categories).

Fourthly, we compared and contrasted categories identified in the individual texts, merging some of them, where necessary.

Finally, we examined each in detail and considered their fitness and relevance.

For questionnaire two (2), three (3) and four (4), quantitative analysis was used. After each round of quessionaire, the results were quantified and summarized and then re-submitted to participants for their comments. For questionnaire two (2) a central tendency measure was calculated for each item in each question, and then the items were ordered by the central values obtained. The central tendency measure used was the median and not the mean, mainly because using the latter would have given too much weight to the extreme values, which could have skewed the group opinion (Garrido, 2009.). For questionnaires three (3) and four (4) a simple table showing the results in percent terms was presented

### 3. Results

The findings are presented in a quantitative format as shown in the following tables:

**Table 1.** Order of importance of characteristics of Corporate Universities

| Rank | Item | Median | Mean | SD | Rank |
|---|---|---|---|---|---|
| 1 | Promoting political culture | 1.0 | 1.3 | .483 | 9th |
| 2 | Serving as ' ideas tanks' for governments, public and private and business strategies | 2.60 | 3.0 | .527 | 2nd |
| 3 | Serving as a forum for exchanging ideas and knowledge between government and society | 1.50 | 1.50 | .527 | 8th |
| 4 | Advocates of continuing strategic alignment with national issues | 2.0 | 2.20 | .632 | 7th |
| 5 | Front-runners in political issues | 2.00 | 2.30 | .483 | 6th |

| 6 | An emerging force in national consensus building. | 3.0 | 2.70 | .483 | 1st |
|---|---|---|---|---|---|
| 7 | institutional development | 2.20 | 1.70 | .675 | 5th |
| 8 | Operating in highly complex and differentiated settings | 2.50 | 2.50 | .527 | 3rd |
| 9 | Contributing to society's economic development and innovation, | 2.50 | 2.40 | .699 | 4th |
| 10 | Promotion of individual, organizational and national learning | 2.20 | 1.70 | .632 | 5th |

Source: Authors' own (2015)

**Table 2:** Traditional universities have the Abilities and capabilities to match corporate universities in Ghana

| | | Frequency | Percent | Valid percent | Cumulative percent |
|---|---|---|---|---|---|
| Valid | 2 disagree | 3 | 30.0 | 30.0 | 30.0 |
| | 3 neutral | 3 | 30.0 | 30.0 | 60.0 |
| | 4 agree | 4 | 40.0 | 40.0 | 100.0 |
| | Total | 10 | 100.0 | 100.0 | |

Source: Authors' own (2015)

**Table 3:** Corporate universities are a potential source of competition for traditional universities in Ghana

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 2 disagree | 6 | 60.0 | | 60.0 |
| | 3 neutral | 4 | 40.0 | | 100.0 |
| | Total | 10 | 100.0 | | |

Source: Authors' own (2015)

**3.2 Contribution**

The outcomes of the research will contribute to a good understanding of the operations of corporate universities. It has made a contribution to the scanty scholarly literature on the operations of corporate universities in Ghana. Beyond Ghana it will contribute to scholarly literature in countries like France, Canada and other countries. The concepts, themes and variables captured in the articles could be used as background knowledge in related quantitative and qualitative studies.

**3.3 Practical implications**

Despite having different identities, missions, visions and objectives, corporate universities and Traditional universities have common goals. They both work for the common good of the people of Ghana. In that case they must see each other as partners rather than competitors in learning and knowledge. Thus they must collaborate with each other to build organizations and communities that promote democracy, consensus building, technological innovations, creativity, problem solving, political stability and ethical behaviors (example, zero tolerance for corruption) that benefit everyone.

**4. Conclusion**

The paper aimed at exploring the potential of corporate universities to compete with traditional universities. It was felt necessary to seek the opinions of experts. The Delphi Model was used for this purpose because of its unique features of confidentiality and its validation. All the research questions were addressed. The conclusion is that corporate universities are not a potential threat to the traditional universities.

**References**

Allen, K. (2002). *The Corporate University Handbook*. AMACOM Div American Mgmt Assn. p. 9. ISBN 978-0-8144-0711-0

Bernice, B. Brown (1968). "*Delphi Process: A Methodology Used for the Elicitation of Opinions of Experts.*": An earlier paper published by RAND (Document No: P-3925, 1968, 15 pages

Creswell, J.W (2009*). Qualitative Inquiry and Research (Second Edition).Choosingamong five approaches*.SAGE Publications

Garcia, G. J. L. (2009). "Futuro de la universidad o universidad del futuro" [online article]. *Fuentes. Revista de la Facultad de Ciencias de la Educación*. No 9, pages 9-25.

Jarvis, P. (2001) *Universities and Corporate Universities*. London: Kogan Page Limited.

Lee, S., Kim, B. G., and Kim, H. (2012). *An integrated view of knowledge management forperformance*.doi:10.1108/13673271211218807

McGee,P(2006).CorporateUniversitities:Collaborators or competitors? *Journal of Human Reosurce and Adult learning, May, 2006.*

Meister, J. (2006, March). "Corporate Universities: What Works and What Doesn't". *Chief learning officer magazine* (US) 29-32, 70.

Philip, McGee (2006) Corporate Universities: Competitors or Collaborators? *The Journal of Human Resource and Adult Learning * May 2006* 28Clemson University, South Carolina

Paton,R.,Peters, G and Quintas P. (2005*) Corporate Education StrategiesUnited Kingdom*.Paper prepared for the Ministério do Desenvolvimento, Indústria e Comércio Exterior, Government of Brazil, Brasília

Norman Dalkey, and Olaf Helmer (1963) *An Experimental Application of the Delphi Method to the use of experts*. Management     Science, 9(3), Apr 1963, pp 458-467

Saunders,M., Lewis,P, and Thornhill,A (2009) *Research Methods for Business Students*. Fifth Edistion.Prentice Hall

Ziglio, E. (1996). The Delphi method and it contribution to decision-making. In MAdler & E.,   *Gazing into the oracle: The Delphi and its application to social policy and public health*. London, England: Jessica Kingsley.

## Performance Analysis of Enhanced Interior Gateway Routing Protocol (Eigrp) over Open Shortest Path First (Ospf) Protocol with OPNET

**Michael Asante, Anibrika [1]Bright Selorm Kodzo [2]**
[1]Computer Science Dept., KNUST, Kumasi, Ghana
[2]Computer Science dept, Koforidua Polytechnic, Ghana
Email: mickasst@yahoo.com, skbselorm@yahoo.com

**Abstract**

Routing protocol is taking a vital role in the modern communication networks. A routing protocol is responsible for determining how routers communicate with each other and forward the packets through the optimal path as it travels from a source node to a destination node. In the context of routing protocol performance, each of them has different architecture, *adaptability, route processing delays and convergence capabilities*. This paper presents a simulation based analysis of Enhanced Interior Gateway Routing Protocol (EIGRP) for real time applications by using OPNET. An evaluation of the proposed routing protocols would be performed based on the quantitative metrics such as *Throughput and Packet Delay Variation* through the simulated network models that would be designed. The evaluation results showed that EIGRP protocol provides a better performance for real time applications. Using OPNET simulation, results were obtained for the specified routing protocols and performance was compared in order to determine the best routing protocol for real-time applications. Each scenario was simulated and results were collected for Throughput and Packet Delay. Analysis of the routing tables of a simple network topology was carried out in order to study the metrics of each protocol and gain a better understanding of how routes are chosen. The analyzed results of simulating the various scenarios identified the routing protocol with the best performance for a large, realistic and scalable network (Shan et al 2000).

**Keywords:** Convergence, Simulation, Protocol, Analysis, Topology, Routes.

## INTRODUCTION

Communication technology facilitates users by providing user friendly services such as file transferring, print sharing, video streaming and voice conferencing. Internet is a global system of interconnected computer networks. Today Internet is playing a vital role in communication networks. Computer communication networks are based on a technology that provides the technical infrastructure, where routing protocols are used to transmit packets across the Internet.

Routing protocols specify how routers communicate with each other by disseminating information. The router has prior knowledge about the adjacent networks which can assist in selecting the routes between two nodes. There are different types of routing protocols in the IP networks.

## RELATED WORK

Many researchers in the past have compared the performance of the two dynamic routing protocols i.e. Interior Gateway Routing Protocol (EIGRP) and Open Shortest path First (OSPF), based on different parameters. (Ittiphon *et al,* 2005), showed the link recovery comparison between OSPF & EIGRP and found that EIGRP is better than OSPF in both retransmission time and rerouting time after the failure of a link. (Shafiul *et al,* 2008), showed the comparative performance analysis of EIGRP and OSPF routing protocols on real time applications such as video streaming on wired and wireless networks. These protocols were evaluated on the basis of quantitative metrics such as convergence duration, packet delay variation, end-to end delay and throughput. Results showed that EIGRP performs better over OSPF on real time video streaming applications. (Sheela and Thorenoor, 2001), presented the implementation decisions to be made when the choice is between protocols that involve distance vector or link state or the combination of both and compared with different parameters. Finally it has been shown

that EIGRP provides a better network convergence time, less bandwidth requirements and better CPU and memory utilization compared to routing protocols like Open Shortest Path First Protocol (OSPFP). The paper compared the two protocols on the basis of E-mail upload response time and Hypertext Transfer Protocol (HTTP) page response time, for different number of workstations (Holmes et al, 2002).

## OBJECTIVES

> To simulate OSPF protocol and EIGRP protocol using OPNET based on two quantitative metrics (Throughput and Packet Delay Variation).
> Analyze the results of simulation.
> To determine a suitable and appropriate protocol for a scalable network.

### Background Theory

In IP networks, a routing protocol usually carries packets by transferring them between different nodes. When considering a network, routing takes place hop by hop.  Routing protocols have the following objectives:

- *To communicate between routers*
- *To construct routing tables*
- *To make routing decisions*
- *To learn existing routes*
- *To share information amongst neighbour's routers.*

*The routers are used mainly by connecting several networks and providing packet forwarding to different networks. The main idea for routing protocols is to establish the best path from the source to the destination. A routing algorithm employs several metrics, which are used to resolve the best method that can be used to get to a network in which case this can be achieved through the use of a single or several properties of the path. For conventional routing protocols, networks are classified as Link State Routing Protocols and Distance Vector Routing Protocols. The conventional routing protocol is usually used for other types of communication networks such as Wireless Ad-Hoc Networks, Wireless Mesh Networks etc (Billings et al, 2002).*

Neighbor Discovery occurs by sending HELLO packets at intervals with a comparatively low overhead. After receiving a HELLO packet from its neighbors, the router ensures that its neighboring routers are active and that   exchange of routing information will be possible.

In the determination of   the best path for transmission some specific metrics such as speed, node delay, congestion, and interference were used.  For instance, OSPF uses bandwidth while RIP (Routing Information Protocol) uses hop count and EIGRP uses a combination of bandwidth and delay.

Metric Parameters

A metric is measured to select the routes as a means of ranking them from most preferred to least preferred. Different metrics were used for different routing protocols.

*In IP (Internet Protocol) routing protocols, the following metrics are used mostly:*

- *Hop count: It counts the number of routers for which a packet traverses in order to reach the destination.*
- *Bandwidth: A bandwidth metric chooses its path based on bandwidth speed thus preferring high bandwidth link over low bandwidth.*
- *Delay: Delay is a measure of the time for a packet to pass through a path. Delay depends on some factors, such as link bandwidth, utilization, physical distance travelled and port queues.*
- *Cost: The network administrator or Internet Operating System (IOS) estimates the cost to specify an ideal route. The cost can be represented either as a metric or a combination of metrics*
- *Load: It is described as the traffic utilization of a defined link. The routing protocol use load in the calculation of a best route.*
- *Reliability: It calculates the link failure probability and it can be calculated from earlier failures or interface error count (Douglas et al, 2006).*

METHODS OF ROUTING

*Each router is responsible for accomplishing the following procedure.*

- *Each router learns about directly connected networks and its own links.*
- *Each router must have a connection with its directly connected adjacent networks and this is usually performed through HELLO packet exchanges.*
- *Each router must send link state packets which contains the state of the links.*
- *Each router stores a link state packet copy which is received by its neighbours.*
- *Each router independently establishes the least cost path for the topology (Lammle et al., 2005).*

## METHODOLOGY

When implementing a real model of the system in the OPNET, an algorithm was followed to the design on the simulator. Figure 3.1 shows a flow chart of the steps

| Start | → | Create Network | → | Choose Statistics | → | Run Simulation | → | Analyze Results | → | End |

*mulation in OPNET flow chart and Design Steps. Figure 3.1*

## OPNET Simulator

*In this thesis, network simulator, Optimized Network Engineering Tools (OPNET) modeler 14.0 has been used as a simulation environment. OPNET is a simulator built on top of Discrete Event System (DES) and it simulates the system behavior by modeling each event in the system and processes it through user defined processes. OPNET is very powerful software to simulate heterogeneous network with various protocols.*

## Structure of the OPNET (Simulation Software)

OPNET is a high level user interface that is built with C and C + + source code with huge library of OPNET function.

Hierarchical Structure of OPNET Model
*OPNET model is divided into three domains. These are:*

• *Network domain:*

Physical connection, interconnection and configuration can be included in the network model. It represents overall system such as network, sub-network on the geographical map to be simulated.

*Node Domain:*

Node domain is an internal infrastructure of the network domain. Node can be routers, workstations, satellite and so on.

• **Process Domain:**

Process domain are used to specify the attribute of the processor and queue model by using source code C and C ++ which is inside the node models.

## Measurements

In this section, measurements of the performance metrics, which is Throughput and Packet Delay Variation are done from the acquired results of Discrete Event Simulation in figure 3.6.Detailed information about the simulation and measurements are explained further below based on the various models created.

## Network Topology under simulation



**Figure 3.6** The proposed network under simulation

In this thesis, three scenarios EIGRP, OSPF and EIGRP_OSPF were created that consists of six interconnected subnets where routers within each subnet are configured by using EIGRP and OSPF routing protocols. The network topology composed of the following network devices and configuration utilities:

- ➢ CS_7200 Cisco Routers
- ➢ Ethernet Server
- ➢ Switch

- ➤ PPP_DS3 Duplex Link
- ➤ PPP_DS1 Duplex Link
- ➤ Ethernet 10 BaseT Duplex Link
- ➤ Ethernet Workstation
- ➤ Six Subnets
- ➤ Application Configuration
- ➤ Profile Configuration
- ➤ Failure Recovery Configuration
- ➤ QoS (Quality of Service) Attribute Configuration

The network topology designed using OPNET as shown in figure3.6. Six subnets that are interconnected to each other were considered. All of the subnets contain routers, switches and workstations. An Application Definition Object and a Profile Definition Object have all been named correspondingly the figure 3.6. Application Config and Profile Config in the figure 3.6 are added from the object palette into the workspace. The Application Config allows generating different types of application traffic. As far as real time applications are concerned in this thesis, the Application Definition Object is set to support Video Streaming (Light) and Voice Conferencing. A Profile Definition Object defines the profiles within the defined application traffic of the Application Definition Objects. Weighted Fair Queuing (WFQ) is a scheduling technique that allows different scheduling priorities on the basis of Type of Service (ToS) and Differentiated Service Code Point (DSCP).The routers are connected using PPP_DS3 duplex link with each other. The switches are connected to routers using same duplex link. Ethernet workstations are connected to switch using 10 Base T duplex links and also links speeds of 44.76 Mbps for the

first set of subnet connection with link type of PPP_DS3 and 1.544 Mbps for the second set of subnet connection with a link type of PPP_DS1 deployment to ensure standard data transmission across the links. The same numbers of bits were sent simulated for the various scenarios (EIGRP, OSPF, and EIGRP_OSPF). In this simulation three network models were created, simulated and measurements were carried out based on two performance metrics that is *Throughput and Packet Delay Variation.*

*"Three network models were simulated, which are configured and run as 1st scenario with OSPF alone, 2nd one with EIGRP alone and 3rd one with both EIGRP and OSPF concurrently".*

Three network models were simulated, which are configured and run as 1st scenario with OSPF alone, 2nd one with EIGRP alone and 3rd one with both EIGRP and OSPF concurrently. One failure link between Sub-E and Sub-D has been configured to occur at 300 seconds and to recover at 500 seconds. The links that have been used in these scenarios are given in Table 3.1 below.

| Link Type | Connection between subnets | Link Speed |
|-----------|---------------------------|------------|
| PPPDS3 | Sub-C<->Sub-F,  Sub-A<->Sub-C<br>Sub-E<->Sub-C,  Sub-B<->Sub-C<br>Sub-E<->Sub-D,  Sub-B<->Sub-D | 44.736 Mbps |
| PPPDS1 | Sub-A<->Sub-E ,Sub-B<->Sub-A<br>Sub-C<->Sub-F | 1.544 Mbps |

Table 3.1: Link connection

**RESULTS OF SIMULATION FOR THE THREE MODELS**

**PACKET DELAY VARIATION SIMULATION FOR EIGRP SCENARIO (model 1)**

| No. of bits sent | Scenario Name | Routing Protocol | Packet Delay (sec) |
|------------------|---------------|------------------|--------------------|
| 5 | EIGRP | EIGRP | 0.026 |
| 10 | EIGRP | EIGRP | 0.028 |
| 15 | EIGRP | EIGRP | 0.030 |
| 20 | EIGRP | EIGRP | 0.032 |

Table 3.2 Packet Delay Variation results for EIGRP

**PACKET DELAY VARIATION SIMULATION FOR OSPF SCENARIO (model 2)**

| No. of bits sent | Scenario Name | Routing Protocol | Packet Delay (sec) |
|------------------|---------------|------------------|--------------------|
| 5 | OSPF | OSPF | 0.043 |
| 10 | OSPF | OSPF | 0.045 |
| 15 | OSPF | OSPF | 0.047 |
| 20 | OSPF | OSPF | 0.049 |

Table 3.3 Packet Delay Variation results for OSPF scenario

**PACKET DELAY VARIATION SIMULATION FOR EIGRP_OSPF Scenario**

| No. of bits sent | Scenario Name | Routing Protocol | Packet Delay (msec) |
|---|---|---|---|
| 5 | EIGRP_OSPF | EIGRP and OSPF | 0.026 |
| 10 | EIGRP_OSPF | EIGRP and OSPF | 0.027 |
| 15 | EIGRP_OSPF | EIGRP and OSPF | 0.028 |
| 20 | EIGRP_OSPF | EIGRP and OSPF | 0.029 |

Table 3.4 Packet Delay Variation results for EIGRP_OSPF scenario

**THROUGHPUT SIMULATION FOR EIGRP SCENARIO**

| No. of bits sent | Scenario Name | Routing Protocol | Throughput (bit/sec) |
|---|---|---|---|
| 5 | EIGRP | EIGRP | 8,80,000 |
| 10 | EIGRP | EIGRP | 8,82,000 |
| 15 | EIGRP | EIGRP | 8,85,000 |
| 20 | EIGRP | EIGRP | 8,87,000 |

Table 3.5 Throughput simulation results for EIGRP

**THROUGHPUT SIMULATION FOR OSPF SCENARIO**

| No. of bits sent | Scenario Name | Routing Protocol | Throughput (bits/sec) |
|---|---|---|---|
| 5 | OSPF | OSPF | 720000 |
| 10 | OSPF | OSPF | 725000 |
| 15 | OSPF | OSPF | 728000 |
| 20 | OSPF | OSPF | 730000 |

Table 3.6 Throughput simulation results for OSPF

**THROUGHPUT SIMULATION FOR EIGRP_OSPF SCENARIO**

| No. of bits sent | Scenario Name | Routing Protocol | Throughput (bits/sec) |
|---|---|---|---|
| 5 | EIGRP_OSPF | EIGRP and OSPF | 8,50,000 |
| 10 | EIGRP_OSPF | EIGRP and OSPF | 8,52,000 |
| 15 | EIGRP_OSPF | EIGRP and OSPF | 8,55,000 |
| 20 | EIGRP_OSPF | EIGRP and OSPF | 8,57,000 |

Table 3.7 Throughput simulation results for EIGRP_OSPF

224

**RESULTS AND FINDINGS**

Introduction

In this section, the results obtained in chapter three are presented with their comparative analysis of EIGRP over OSPF. Three network models were simulated, which are configured and run as 1st scenario with OSPF alone, 2nd one with EIGRP alone and 3rd one with both EIGRP and OSPF concurrently. One failure link between Sub-E and Sub-D has been configured to occur at 300 seconds and to recover at 500 seconds.

Packet delay variation graph

Packet delay variation is measured by the difference in the delay of the packets. This metric has huge influence on the manners of video and voice applications. From the figure 3.4, the linear time variation increases starting from bits 5 to bits 20 showing that with the increase in traffic for voice and video applications the delay in packet transmission increase and EIGRP is slow to resolve packet delays when there is network congestion, and this also results in broken packet sizes before arriving at the destination, poor error detection and correction mechanisms and also poor bit synchronization may be the possible causes.
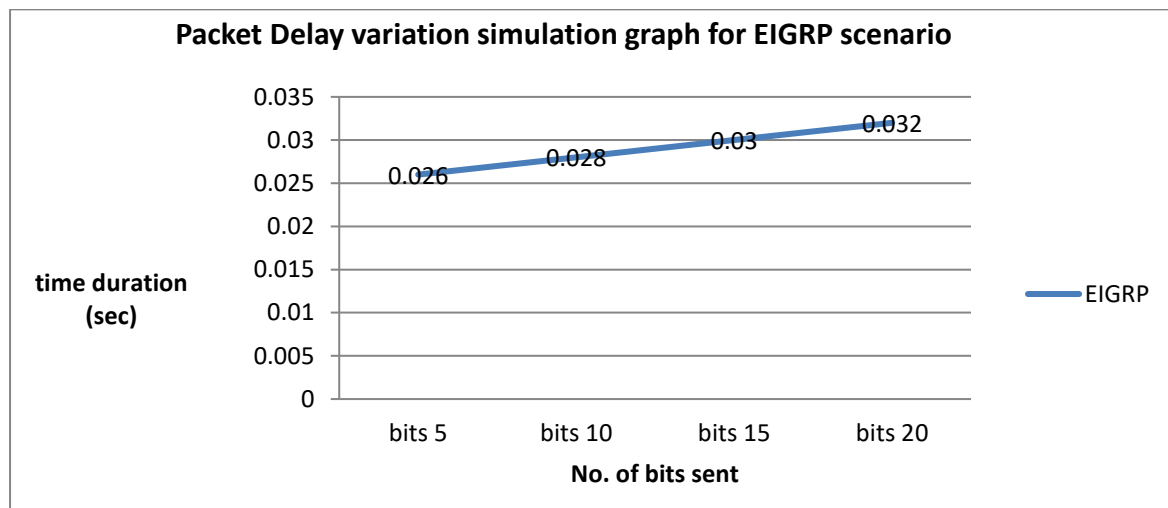


**Figure 3.4:** Packet delay variation graph

**Throughput simulation graph**

The throughput is a key parameter to determine the rate at which total data packets are successfully delivered through the channel in the network. Figure 4.5 indicates that, bits 20 have high throughput and less packet loss than bits 5, bits 10 and bits 15 respectively. This means that EIGRP is efficient in handling throughput and packet loss during network congestion periods and therefore leads better error detection and correction, bit synchronization and faster routing table update interval time by EIGRP. Find below figure 4.5
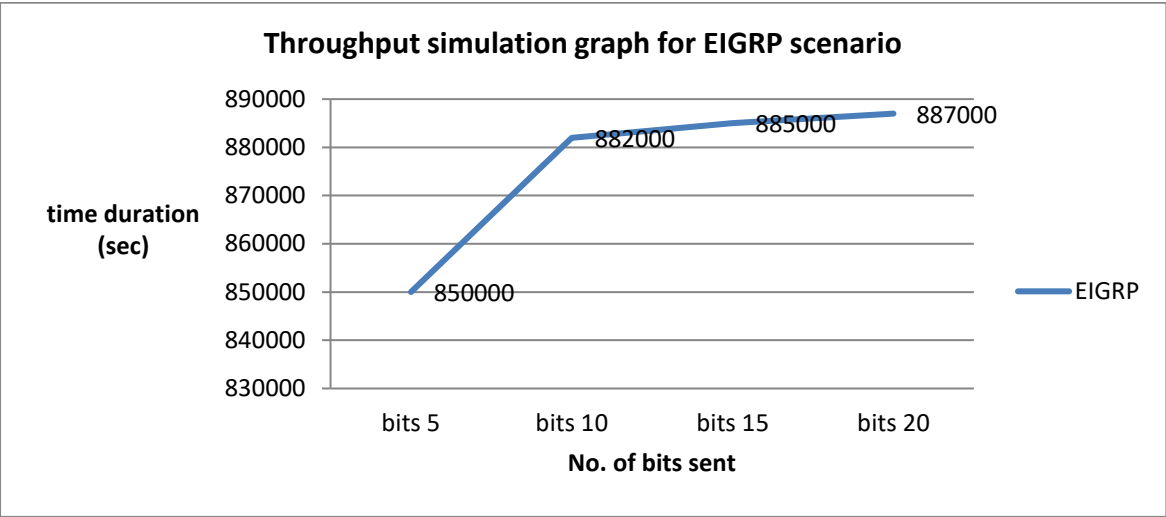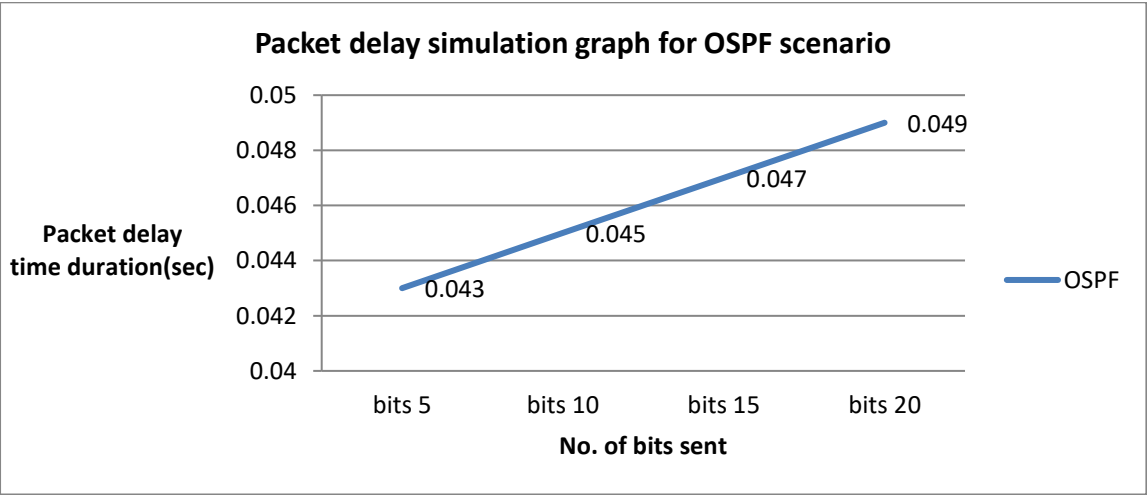
**Figure 4.5** Throughput simulation graph

**4.8 Packet delay simulation graph**
This metric has huge influence on the manners of video applications. It is observed from the figure 4.7 that, the packet delay variation for OSPF networks are having higher values especially for that of bits 20 when it was sent through the OSPF network. Due to this, OSPF used triggered updates that allow efficient use of bandwidth and faster convergence time and not as susceptible to routing loops as EIGRP but requires more memory and processing power and harder to configure than EIGRP.



**Packet Delay simulation graph for OSPF protocol**

**4.13 Packet delay simulation graph for EIGRP_OSPF** scenario
Packet Delay variation is measured by the difference in the delay of the packets. This metric has huge influence on the manners of video applications. It is observed from the figure 4.12 that EIGRP_OSPF has less packet delay variation than EIGRP and OSPF networks. Apparently, Figure 4.13 shown that despite of high congestion in the network, EIGR_POSPF is much better than OSPF and EIGRP network protocols in terms of packet

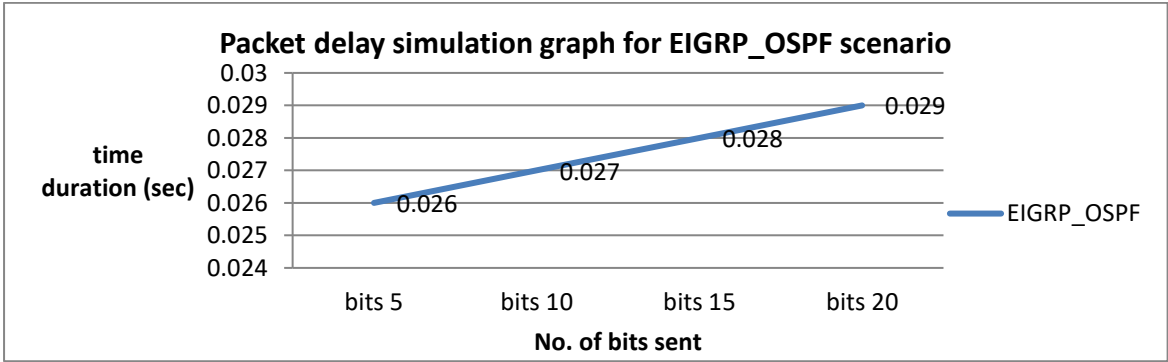delay variation and ensures efficient packet delivery.

**Packet delay simulation graph for EIGRP_OSPF scenario**

Figure 4.12 Packet delay simulation graph for EIGRP_OSPF scenario

## 4.15 Throughput simulation graph for EIGRP_OSPF

The throughput is a key parameter to determine the rate at which total data packets are successfully delivered through the channel in the network. Figure 4.14 indicates that El GRP_OSPF has higher throughput and less packet loss than OSPF and ElGRP networks especially for bits 15 and 20 respectively indicating an efficient network performance protocol suitable for voice and video applications .In effect EIGRP_OSPF has a better mechanism to ensure faster convergence and high throughput during data transmission especially where network congestion is rampant.
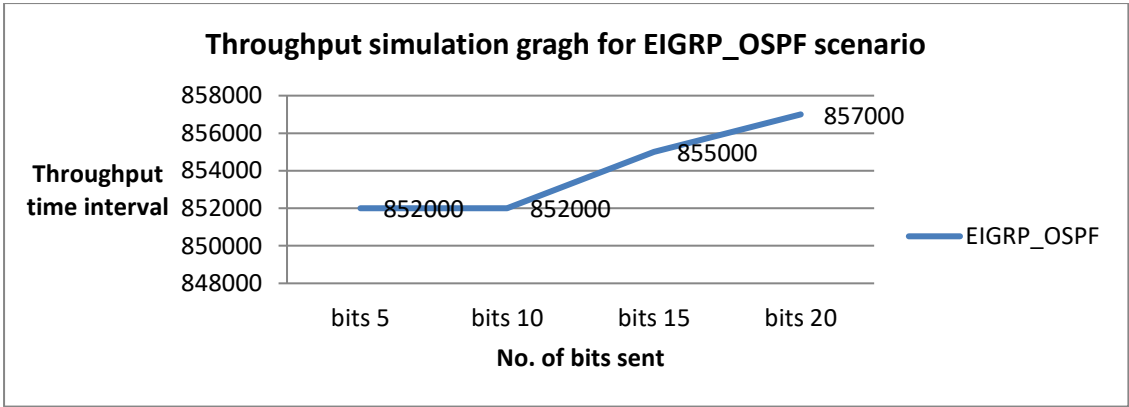
**Throughput simulation gragh for EIGRP_OSPF scenario**

Figure 4.14 Throughput simulation graph for EIGRP_OSPF

## CONCLUSION/RECOMMENDATIONS

Interior routing protocols like EIGRP and OSPF are widely being used in the computer networking. In this thesis, I have presented a comparative analysis of selected routing protocols such as EIGRP, OSPF and the combination of EIGRP and OSPF. Network scalability can be enhanced by reducing network convergence time of the routing protocol. In this thesis work, implementation of EIGRP shows that network convergence time is much faster than EIGRP_OSPF and OSPF networks because EIGRP network learns the topology information and updates faster than EIGRP_OSPF and OSPF. The simulation result has shown that end to end delay of

EIGRP_OSPF network is relatively less than EIGRP and OSPF networks. As a result, data packets in EIGRP_OSPF network reach faster to the destination. Another performance metrics for real time application is packet delay variation, which measures the differences between the delays of packets. The performance of packet delay variation for EIGRP_OSPF is better than OSPF and EIGRP. Also the packet delay variation of EIGRP and OSPF networks is high while EIGRP_OSPF network is low. In the context of packet loss, it was found that packet loss in the EIGRP_OSPF network is less than OSPF and EIGRP networks. In comparison, the simulation results have shown that the throughput in the combination of EIGRP and OSPF network is much higher than OSPF and EIGRP networks. In this thesis work, the comparative performance among EIGRP, OSPF and combination of EIGRP and OSPF routing protocols for real time application has been analyzed. By comparing these protocols' performances, it is observed that the combined implementation of EIGRP and OSPF routing protocols in the network performs better than OSPF and EIGRP.

**REFERENCES**

Christian Huitema, "Routing in the internet" 2. Ed. Prentice Hall PTR, cop. 2000. Cisco "OSPF Design Guide" http://www.cisco.com/en/US/tech/tk365/technologies_white_paper09186a0080094e9e.shtml.

Cisco, "Internet Technology Handbook" http://www.cisco.com/en/US/docs/internetworking/technology/ handbook/Enhanced_lGRP. Html.

Cisco, "IP Routing, Introduction to EIGRP" Document l D: 13669.http://www.cisco.com/en/US/tech/tk365/technologies_tech_note091 86a0080093f07.s html# hw.

Douglas E. Comer, "Internetworking with TCP/IP, Principles, Protocols and Architecture" 5th ed. Vol.1, Pearson Prentice Hall, 2006.

David Billings,"A collection of materials for the study of intranet and internet networking" GTCC. http://www.gtcc-it.net/billings/eigrp.html.

Esuendale Lemma; Syed Hussain; WendwossenAnjelo; "Performance Comparison of EIGRP/ IS-IS and OSPF/IS-IS" Blekinge Tekniska Hogskolan. Sweden, 2010.http://www.essays.se/essay/cc996c9 ff/.

FarazShamim, Zaheer Aziz, Johnson Liu, Abe Martey, "Troubleshooting IP Routing Protocols" Cisco Press, Pages: 912, May 07, 2002.

# Predicting Students Academic Performance using Naive Bayes Algorithm

**Sujith Jayaprakash [1], Balamurugan E. [2]**
BlueCrest College, Accra, Ghana
Email: e.balamurugan@bluecrest.edu.gh

## Abstract

In the present days, education plays a vital role to stimulate the people to lead their life more comfortable. Due to sudden rising of various educational institutions all around the world most of the institutions are trying hard to survive. Institutions offering specially higher education are striving hard to maintain the quality offered to the students. There are lots of factors are influencing the quality of education institutions like Infrastructure, Teaching and learning methods, Laboratories, Campus Placements, Linkages with Industries etc. One among the major factor which influences the quality of an institution is the student feedback. Now a days institutions are paying more attention towards the student feedback on their experience with their lecturers on the quality of delivery of course content's in Classroom. Retention of institutions with a good numbers is dependent on the understanding and satisfying students need. Hence maintaining high quality standards is eminent for any institution to improve the academic performance of students and to retain them in the system. In this paper, Naive Bayes algorithm is applied for predicting student's academic performance at the end semester exams by analyzing students feedback and their performance in the mid-semester exams. This work helps the educational institutions to identify the weaker studens in advance and arrange necessary training before they are going to appear for their final exams.

**Keywords**: Naive Bayes Algorithm, Student Feedback, Academic Performance, Student Retention, Knowledge discovery.

## INTRODUCTION

Data mining has been used in the areas of Science and Engineering, such as Education, Genetics, Medicine, Bioinformatics and electical power engineering. Data mining techniques and tools are used to extract meaning from large set of data generated to peoples learning activites. It has been widely used in the areas of Business to analyse the Customer Relation Management, Human Resource management, marketing etc., Data Mining has high impact in the Business sector, Education is also tapping into the power of Data Mining.

Data mining (sometimes called data or knowledge discovery) is the process of analyzing data from different perspectives and summarizing it into useful information. Information that can be used to increase revenue, cuts costs, or both. It can be classified as Supervised and Unsupervised learning. In the supervised learning classification requires the training data has to specify what we are trying to learn (the classes) and where as in unsupervised learning the training data doesn't specify what we are trying to learn (the clusters). Supervised learning is analogous to human learning from past experiences to gain new knowledge in order to improve our ability to real world tasks [1]. Various algorithms are used to perform supervised learning and few among them are Symbolic Machine Learning algorithm, Semisymbolic machine

learning algorithm, Nearest Neighbour Algorithm, Naive Bayes algorithm.

The Naive Bayes algorithm is a simple probabilistic classifier which is based on Bayes theorem with strong and naive independence assumptions. It is one of the most basic classification techniques with various applications in email spam detection, personal email sorting, document categorization, sexually explicit content detection, language detection and sentiment detection. Despite the naive design and oversimplified assumptions that this technique uses, Naive Bayes performs well in many complex real-world problems. Naive Bayes algorithm is highly scalable and requires a number of parameters linear in the number of variables. A Naive Bayes classifier is a simple probabilistic classifier based on applying Bayes' theorem (from Bayesian statistics) with strong (naive) independence assumptions. In simple terms, a naive Bayes classifier assumes that the presence (or absence) of a particular feature of a class is unrelated to the presence (or absence) of any other feature. Several colleges and universities have adopted feedback analysis system using various models in data-mining to improve student retention and to channel students to courses and programs that the institutions judge most appropriate.

In this paper, Supervised learning approach through Naives Bayes algorithm Ayinde et al.(2010) is used for the prediction of final examination results of student's based on their Feedback and their mid semester results as a training data to analyse their academic performance. Various attributes of Students feedback has been taken as dependent variables and mid semester exam result is taken as a explanatory variable. This paper is organised as chapter I : Introduction, Chapter II :Related works, Chapter III : Proposed Methodology, Chapter IV : Results and Discussions Chapter V : Conclusion.

## RELATED WORKS

Contemporaneous researches are introduced using various data mining technique to analysis the academic performance of students at various levels, following are the few of some especially used for academic progression in various modes.

Wook M et al. (2009) compared two data mining techniques which are: Artificial Neural Network and the combination of clustering and decision tree classification techniques for predicting and classifying student's academic performance. As a result, the technique that provides accurate prediction and classification was chosen as the best model. Using this model, the pattern that influences the student's academic performance was identified. Suresh K Yadav et al. (2012) obtained the university students data such as attendance, class test, seminar and assignment marks from the students' database, to predict the performance at the end of the semester using three algorithms ID3, C4.5 and CART and shows that CART is the best algorithm for classification of data [3]. Thai-Nghe et al. (2007) compared the accuracy of decision tree and Bayesian network algorithms for predicting the academic performance of undergraduate and postgraduate students at two different academic institutes. These predictions are most useful for identifying and assisting failing students, and better determine scholarships. As a result, the decision tree classifier provides better accuracy in comparison with the Bayesian network classifier [4]. Alam et al. (2012) have presented a novel algorithm implementing decision trees to maximize the profit-based objective function under resource constraints. More specifically, they take any decision tree as input, and mine the best actions to be chosen in order to maximize the expected net profit of all the customers. NBTree - The Naive Bayesian tree learner, NBTree (Kohavi 1996), combined Naive Bayesian classification and decision tree

learning. Bayesian classifiers are statistical classifier. The Naive Bayes algorithm is a simple probabilistic classifier that calculates a set of probabilities by counting the frequency and combinations of values in a given data set. In an NBTree, a local naive Bayes is deployed on each leaf of a traditional decision tree, and an instance is classified using the local naive Bayes on the leaf into which it falls. After a tree is grown, a naive Bayes is constructed for each leaf using the data associated with that leaf. An NBTree classifies an example by sorting it to a leaf and applying the naive Bayes in that leaf to assign a class label to it.

## METHODOLOGY

In this research proposed data mining technique is for predicting student's academic performance by analyzing student's feedback using Naive Bayes algorithm [5]. The research process includes the following process (Figure 1).

A. Data Selection

B. Data Transformation

C. Implementation of Naive Bayes algorithm

D. Classification

### A. Data Selection :

The data herein was collected by means of feedback rating-scale questionnaire, which is presented in Table 1. In Table 1 there are nine questions which completely related to teaching and learning process of an institute. The questions in the questionnaire are measured with a scale value of 1 to 5 whereas in Table 2. Then, the data was collected from 700 students in various departments of BlueCrest College, Accra, Ghana in the academic year 2014 with the internal examination score. The internal score is taken as an average course wise score (Average of Internal test I and Internal Test II).

Figure 1: Proposed student's academic performance analysis model.
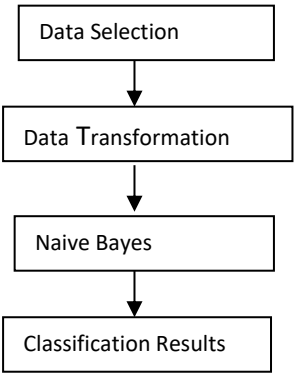


### B. Data Transformation :

The data derived from the feedback questionnaire was transformed into the proper format in order to be analysed based on naive Bayes model.

Table 1: Variables for Data Classification (Questionnaire)

| S.No. | Description | Value |
|-------|-------------|-------|
| 1. | Do you feel supported by your lecturers? | All the mentioned description parameters are measured using a feedback scale score. |
| 2. | Are your lecturers helpful? | |
| 3. | Are lecturers readily available for consultation out of lectures/ tutorials? | |
| 4. | Do lecturers display concern for students as individuals? | 1. Below average |
| 5. | Do lecturers make the subject content of the lecture/ tutorial as interesting as possible? | 2. Average 3. Satisfactory 4. Good 5. Excellent |
| 6. | Is the lecturer able to keep your interest at high level throughout the class? | |
| 7. | Do lecturers engage with you during the lecture/ tutorial? | |
| 8. | Do lecturers seem interested in student's queries during the lecture/tutorial? | |
| 9. | Are the methods of teaching used by your lecturers innovative? | |

Table 2 : Variables for Feedback Measures (Scale)

| S.No | Measures | Scale Values |
|------|----------|--------------|
| a | Below average | 1 |
| b | Average | 2 |
| c | Satisfactory | 3 |
| d | Good | 4 |
| e | Excellent | 5 |

### C. Implementation of Naive Bayes algorithm

The Naive Bayesian algorithm is based on Bayes theorem with independence assumptions between predictors. A Naive Bayesian model is easy to build, with no complicated iterative parameter estimation which makes it particularly useful for very large datasets. Despite its simplicity, the Naive Bayesian classifier often does surprisingly well and is widely used because it often outperforms more sophisticated classification methods.

Bayes theorem provides a way of calculating the posterior probability, $P(c|x)$, from $P(c)$, $P(x)$, and $P(x|c)$. Naive Bayes classifier assumes that the effect of the value of a predictor $(x)$ on a given class $(c)$ is independent of the values of other predictors. This assumption is called class conditional independence.

$$P(c|x) = P(x|c).P(c)/P(x) \qquad (1)$$

- $P(c|x)$ is the posterior probability of class (target) given predictor (attribute).
- $P(c)$ is the prior probability of class.
- $P(x|c)$ is the likelihood which is the probability of predictor given class.
- $P(x)$ is the prior probability of predictor.

### D. Classification rule

Classification rule is generated based on the classification process based on users request or research needs. This can be derived specially for the needs on

better understanding for each class of data in a database.

MAP: Maximum A Posterior rule generation for feedback prediction.

Assign $x$ to $c^*$ if

$$P(C = c^* / \mathbf{X} = \mathbf{x}) > P(C = c / \mathbf{X} = \mathbf{x}) \quad c \neq c^*, \ c = c_1, \cdots, c_L$$

(2)

**Generative classification with the MAP rule**

Apply Bayesian rule to convert them into posterior probabilities from (1) and (2).

$$P(C = c_i / \mathbf{X} = \mathbf{x}) = \frac{P(\mathbf{X} = \mathbf{x} / C = c_i) P(C = c_i)}{P(\mathbf{X} = \mathbf{x})}$$
$$\propto P(\mathbf{X} = \mathbf{x} / C = c_i) P(C = c_i)$$
$$\text{for } i = 1, 2, \cdots, L$$

(3)

The implementation work is based on the collected data which possess various data mining aspects [6]. The Student data is taken into account for the performance prediction. The proposed research work is categorized into two modules. First the feedback results are analysed and same is compared with the internal test performance.

The same can be implemented using open source language Java whereas problem is designed as follows:

(i) Input : Sample values for Naive Bayes algorithm

(ii) Input values are given with a scale value between 1 to 5 for all the 9 feedback questioners.

(iii) Mean, Variation values are computed for each questions in the Questionnaire.

(iv) Evidence value is computed

(v) Posterior value is calculated for PASS

(vi) Posterior value is calculated for FAIL

(vii) Based on the Evidence value Prediction value is calculated.

(viii) Output : Prediction of student result is PASS / FAIL

**Procedure 1: Implementation of naive Bayes Algorithm**

For the above implementation test samples were taken from the student's feedback and same as transformed as input for the Procedure 1 finally the prediction result is shown as PASS / FAIL. For implementation a random sample of 200 values are taken from the student feedback dataset and the values are imported to Ms-SQL database and same can be given as input for procedure 1. Output for the result dataset with a value of PASS/FAIL.

**RESULTS AND DISCUSSIONS**

Data samples are taken out of a total number of 700 student's record dataset, we chosen sample 200 students record for our analysis [7]. The confusion matrix [8] demonstrates number of pass, fail in an Internal Examination. The performance of the above algorithm evaluated using the following three methods are explained below:

**Performance Measures**

There are some parameters on the basis of which the performance of the classifiers such as TP rate, FP rate, precision, Recall, F- Measure was evaluated. The Accuracy of a classifier on a given test set is the percentage of test set tuples that are correctly classified by the classifier. The Error Rate or Misclassification rate of a classifier M, which is 1-Acc (M), where Acc (M) is the accuracy of M. The Confusion Matrix is a useful tool for analysing how well the classifier can recognize tuples of different classes. The sensitivity and specificity measures can be used to calculate accuracy of classifiers. Sensitivity is also referred to as the true

positive rate (the proportion of positive tuples that are correctly identified), while Specificity is the true negative rate (that is, the proportion of negative tuples that are correctly identified). These measures are defined as follows

$$Sensitivity = \frac{(T-Pos)}{Pos} \qquad (4)$$

$$Specificity = \frac{(T-Neg)}{Neg} \qquad (5)$$

$$Precision = \frac{(T-Pos)}{(T-Pos)+(F-Pos)} \qquad (6)$$

Where T-Pos is the number of true positives tuples that were correctly classified, Pos is the number of positive tuples, T-Neg is the number of true negatives tuples that were correctly classified, Neg is the number of negative tuples, and F-Pos is the number of false positives tuples that were incorrectly labelled. It can be shown that accuracy is a function of sensitivity and specificity:

$$Accuracy = \text{sensitivity } \frac{Pos)}{(Pos+Neg)} +$$

$$\text{Specifity } \frac{(Neg)}{(Pos+Neg)} \qquad (7)$$

**True Positive Rate:** It is the proportion of actual positives which are predicted as positive. The formula is defines as,

$$TP\ Rate = \frac{(Tp)}{(Tp+Fn)} \qquad (8)$$

Where $Tp$ stands for true positive and $Fn$ stands for false negative.

**FP rate:** It is the rate of negatives tuples that are incorrectly labelled. The formula is defined as,

$$FP\ Rate\ of\ class\ \text{"PASS"} = \frac{(Fn)}{(Tp+Fn)} \qquad (9.a)$$

$$FP\ Rate\ of\ class\ \text{"FAIL"} = \frac{(Fp)}{(Tp+Fp)} \qquad (9.b)$$

**Table 2.** Confusion matrix

| Total samples taken | PASS | FAIL |
|---|---|---|
| 200 | 0 | 0 |
| 0 | 166 | 0 |
| 0 | 0 | 34 |

From a total number of 700 student's record, a sample of 200 student's record has been chosen and analysed. The confusion matrix demonstrates number of pass, fail in their internal examination. Number of pass students are 166. Number of Fail student is 34. The data analysis is performed with the methods of precision, recall and f-measure. These three methods are explained below:

**Precision**

Prediction is a calculation of positive predicted values precision, which is the fraction of retrieved documents that are relevant. The precision is calculated using the formula as:

$$Precision = \frac{(T-Pos)}{(T-Pos)+(F-Pos)} \qquad (10)$$

Precision takes all retrieved documents into account, but it can also be evaluated at a given cut-off rank, considering only the topmost results returned by the system. This measure is called precision at n.

**Recall**

Recall in information retrieval is the fraction of the documents that are relevant to the query and that are successfully retrieved. The formula for recall is as given below.

$$Recall = \frac{(T-Pos)}{(T-Pos)+(F-neg)} \qquad (11)$$

**F-Measure**

This is a measure that combines precision and recall, a harmonic mean of precision and recall, is known as the traditional F-measure.

$$Fmeasure = 2 * \frac{(Precission*Recall)}{(Precession)+(Recall)} \qquad (12)$$

**Table 3.** Performance Measures

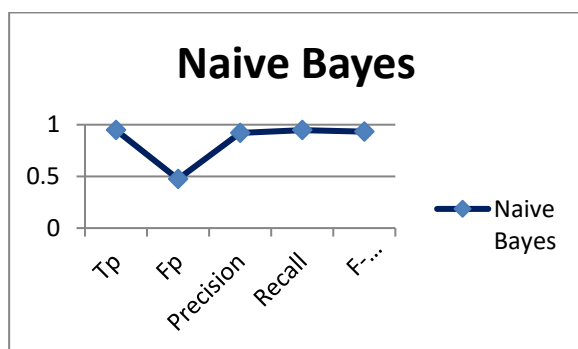| Algorithm | Tp | Fp | Precision | Recall | F-Measure |
|---|---|---|---|---|---|
| Naive Bayes | 0.947 | 0.474 | 0.922 | 0.947 | 00.934 |



**Figure 2**. Representation of Performance measure values

**CONCLUSIONS**

Using Naive Bayes algorithm, we predicted the pass percentage and fail percentage of the Overall students appeared for a particular examination with a comparison of their feedback regarding their course sessions and internal marks. The results show the

students' performance and it is seems to be accurate. The comparison between feedback and internal examination marks Navie Bayes algorithm gives the better prediction result and it is measured using confusion matrix. The results are predicted within 2 seconds. This simple analysis works show that the proper data mining application on student's performance data can be efficiently used for vital hidden knowledge / information retrieval from the vast data, which can be used for the process of decision making by the management of an educational institution. It helps the institutions to identify the weaker students in advance and they can arrange special measures to get good score. This paper also concludes with that for data mining application for effective and faster results prediction, classification and clustering and the institutions can improve their quality based on the analysis and to conduct the special training to their students.

**References**

Alam, M. and Alam, S. (2012). Actionable Knowledge Mining from Improved Post Processing Decision Trees, *International Conference on Computing and Control Engineering*, pp. 1-8.

Ayinde, A. Adetunji, A. Bello, M. and Odeniyi, O. (2013). Performance Evaluation of Naive Bayes and Decision Stump Algorithms in Mining Students' Educational Data. "*IJCSI International Journal of Computer Science Issues, Vol. 10, Issue 4*".

Azwa Abdul Aziz and Nor Hafieza Ismailand Fadhilah Ahmad, *(2014).* First Semester Computer Science Students' Academic Performances Analysis by Using Data Mining Classification Algorithms, *Proceeding of the International Conference on*

*Artificial Intelligence and Computer Science*, ***pp.*** 15-16.

Durairaj, M. and Vanitha, M. (2014). Educational Data mining for Prediction of Student Performance Using Clustering Algorithms, *International Journal of Computer Science and Information Technologies*, pp. 5987-5991.

Jason, D. and Rennie, M. and Lawrence, S. (2010). Tackling the Poor Assumptions of Naive Bayes Text Classifiers, "Artificial Intelligence Laboratory".

Liu, B. (2011). Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data, Data-Centric Systems and Applications, *Springer-Verlag Berlin Heidelber,* pp. 63-68.

Rauf, A. and Sheeba (2012). Enhanced K-Mean Clustering Algorithm to Reduce Number of Iterations and Time Complexity, *Middle-East Journal of Scientific Research*, pp. 959-963.

Thai-Nghe, N. Busche, A. and Schmidt-Thieme, L. (2009). Improving Academic Performance Prediction by Dealing with Class Imbalance, *International Swaps and Derivatives Association*, pp. 878-883.

**Life Cycle Cost for Sustainable Construction Ghana**

**John Hayford[1], William Gyadu-Asiedu[2]**
Koforidua polytechnic
Email: willgyas@yahoo.com

**Abstract**

Life cycle costing (LCC) is a technique to estimate the total cost of ownership by quantifying the cost of whole buildings, systems and/or building components. This technique is used to assist

decision-making for building investment projects. The process usually includes steps such as planning of LCC analysis (e.g. definition of objectives), selection and development of LCC model (e.g. designing cost breakdown structure, identifying data sources and uncertainties), application of LCC model, and documentation and review of LCC results . Even though extensive research work exists on LCC its application is no so widespread (Langdon, 2006). This is especially so in the developing countries. This proposal seeks to explore the feasibility of the use of LCC in the Ghanaian Construction Industry with the aim of supporting sustainable construction. The main significant of the study is to bring cost studies in the built environment in line with best practices in the developed world and to support value for money on all projects.

## 1.1 Background

In the building and construction industry Life cycle costing (LCC) is a technique to estimate the total cost of ownership by quantifying the cost of whole buildings, systems and/or building components (OGC, 2003; Flanagan et al., 1989). This technique is used to assist decision-making for building investment projects (Flanagan et al., 1989). A LCC process usually includes steps such as planning of LCC analysis (e.g. definition of objectives), selection and development of LCC model (e.g. designing cost breakdown structure, identifying data sources and uncertainties), application of LCC model, and documentation and review of LCC results (NSW Treasury, 2004). Even though extensive research work exists on LCC its application is no so widespread (Langdon, 2006). This is especially so in the developing countries.

LCC is relevant throughout the design and construction process but in particular during the planning and design of the project (Kehily, 2011). Kehily (2011) posits that the quality of both the design and construction of the project has a significant bearing on the costs of the building in use. Projects where the design team solely focus on reducing capital costs can lead to a building which is

expensive to maintain, operate, occupy and eventually dispose of. The concept of LCC is based on the theory that decisions made early in the design process can have a considerable influence on LCC, thus careful consideration should be given during the design and procurement process to the costs of the building throughout its life cycle. The focus on LCC usually start at the business justification stage when a conscious informed decision may be taken to increase value in an operational aspect while keeping maintenance as low as possible. Each stage a There are practical difficulties, though, in making such an informed LCC decisions at early stages of a design because of possible lack of enough detailed information to carry out calculations.

Typically, LCCA may be used during the following four key stages of the life cycle of any constructed asset (Kehily, 2011):

a) project investment and planning; WLC/LCC strategic options analyses; preconstruction;

b) design and construction; LCC during construction, at scheme, functional, system and detailed component levels;

c) during occupation; LCC during occupation (cost-in-use); post-construction; and

d) disposal; LCC at end-of-life/end-of-interest

Due to the environmental load imposed by the construction industry, there has been an urge to make the construction supply chain more sustainable (CIB, 1999). Research work has been actively undertaken to develop methods and tools to assess the sustainability of a building, mainly in the environmental aspect. Life cycle assessment (LCA) has been adopted as the technique to assess the environmental performance of a building throughout its life cycle, and ISO standards have been established to provide a common framework.

### 1.2 Problem Statement

The general trend of cost in the Ghanaian construction industry has generally being one of positive increase in the midst of a general call for value for money by clients. The practice of project costing has been largely without consideration of its whole life. The concept of life cycle costing has so far been of no practical relevance to the Ghanaian construction industry largely due the process of project procurement as dictated to by the Public procurement Act (Act 663). This stipulates that government projects should go through a competitive tender of which the lowest evaluated bidder wins. This winning "bid", for all practical purposes represents only the cost of the project based only on market prices.

The period of preparation for project implementation and the process of allocation project public funds (usually by the Ministry of Finance) has meant that consultant must always design to cost. Thus, it has not been an issue to consider the whole life of the building during the tendering stages.

### 1.3 Aim of the Study

The aim of the study is to investigate into the cost management practices of the construction sector in order to identify an adaptive method for evaluating life cycle costing (LCC) that will support sustainable construction in Ghana. The overall aim of the study is to help improve the competitiveness of the construction sector.

To help achieve this aim, the following key objectives shall be pursued:

1. To identify the construction project cost management practices in Ghana
2. To identify the level of awareness and practice of LCC in the construction industry in Ghana
3. To identify the challenges confronting the practice of LCC in Ghana
4. To propose a method of LCC in Ghana that will support sustainable construction

### 1.4 Research Question

- Is LCC really practiced in Ghana?
- How can a methodology of LCC be developed that will be suitable for

practice in Ghana in order to support sustainable construction?

## 1.5. Scope

The study shall focus on cost issues within the construction industry and will involve both road and building works. Data shall be obtained from across the country concerning the cost management practices.

## 1.6 Justification of the Study

The following benefits provide a justification for the study:

The results will improve the wealth of knowledge in academia concerning the theory and practice of LCC.

It will also create the needed awareness of LCC and its implication for the industry's growth and sustainability. For the construction industry, the findings will improve competitiveness and improve he supply chain, value offered to clients, and clients' confidence to invest through robust and appropriate LCC approach. It will improve long-term cost optimisation and forecast certainties. It will also help in improving the reliability of project information, predictive methods, risk assessment and innovation in decision-making for procurement.

## 1.7 Methodology

The study shall begin with the review of relevant literature; these shall be obtained from journals, conference papers, textbooks and other relevant documents. This will form the secondary information. This shall be followed with primary data. This will comprise an interview (using interview guide), a survey (using questionnaires) and a library study (using LCC documents).

These shall be analysed using the appropriate data and software. Based on the analysis and discussion conclusion shall be drawn. This will culminate in the development of the LCC Method.

## 1.8. Work Programmes

### WP1. Literature review (6 Months)

A critical review of the LCC methodologies, guidelines and tools existing elsewhere. The review shall cover a representative number of national cases in Europe, including those from the United Kingdom, Germany, the Netherlands, Sweden, Finland, Norway, Ireland, Span Greece and Czech Republic. The review shall explain the scope and the extent of the different approaches and assesses their methodologies as well as the robustness of models used and the relevance of results to those to whom they are addressed. It also provides an indication of the user-friendly orientation of supporting software tool, their architecture, the levels of aggregation of the information, the transparency of the assumptions and calculation methods, the compatibility with other software and the potential transferability to other national contexts.

### WP2. Field Study (6 MONTHS)

The purpose shall be to investigate the cost management practices within the Ghanaian construction industry and to identify the awareness of LCC practice in Ghana.

## WP3. The LCC methodology (8 Months)

To be developed on the basis of the results of the Literature Review and fieldwork to establish common elements of good practice in LCC in construction in selected EU countries. The requirements of a possible Ghanaian common methodology are intended to cover, *inter alia*, simplicity of use, transparency of information about cost and indicators calculations, reliability of data and information used or generated as well as the interface with national input/data. The methodology is also intended to provide details on how all stages of the project life cycle and the basic elements of the constructed asset or facility would be dealt with at different levels of decision making or appraisal: strategic, system and detail level. It was also intended to comment on possible thresholds for the scale of projects that should be subject to LCC, in particular for the purpose of public procurement.

## WP4. Validation of Methodology (6 Months)

This is intended to test and validate the above-mentioned LCC common methodology. A selection of Experts within the industry shall be used the intention is to include some 4 public procurements and 2 private projects.

### References

Flanagan, R., Norman, G., Meadows, J. & Robinson, G. (1989), Life Cycle Costing Theory and Practice. Oxford: BSP Professional Books

Kehily, D. (2011) Guide to Life Cycle Costing. Working Group on Sustainability and Life Cycle Costing. SCSI.

Langdon, D. (2001) Life Cycle Costing as a Contribution to Sustainable Construction: A Common Methodology

NSW Treasury (2004) Life Cycle Costing Guidelineshttp://www.treasury.nsw.gov.au/__data/assets/pdf_file/0005/5099/life_cycle_costings.pdf.

OGC (2003). *Whole Life Costing and Cost Management - Procurement Guide*. Office of Government Commerce, HM Treasury, London, United Kingdom

**Sustainable Construction Waste Management Strategy in Ghana – A Framework for 'Reduce', 'Recycle' and 'Reuse' Of Construction Materials**

**Emanuel Yaw Frempong Jnr[1] and William Gyadu-Asiedu[2]**
Koforidua polytechnic
Email: sorbibor2000@yahoo.com & willgyas@yahoo.com

**Abstract**

According to The Brundtland committee defines sustainable development as developments that meet the needs of the present without compromising the ability of the future generation to meet their own needs. The definition by the Brudtland committee suggests three important components of sustainable development and these are: (1) what is to be sustained, (2) what is to be developed, and (3) the intergenerational components. The three dimensions of sustainable development have been identified as (1) the social (2) the economic and (3) the environment. Waste management affects carbon reduction efforts by impacting one or more of the following: Energy consumption, Non-energy-related manufacturing emissions, and Methane emission from landfills. It is estimated that anywhere from 25 to 40 percent of the national solid waste stream is building-related waste and only 20 percent of construction waste or demolition debris (C&D) is actually recycled. Waste from building demolition represents 30-50% of total waste in most of these countries. Therefore deconstruction is proposed as an alternative to demolition. However, in a developing country like Ghana, it is expected that strategic waste management would call for a combination of several approaches which support waste management throughout the construction process. The three well known approaches are the 3-Rs: Reduce, Recycle and Re-use (e.g. Resource Venture, 2005). The last part is possible only when deconstruction is possible. This proposal seeks to provide a means by which sustainable construction could be supported through the practical implementation of the 3-Rs.

**1.1 Background**

According to the Brundtland committee, sustainability is defined as developments that meet the needs of the present without compromising the ability of the future generation to meet their own needs (Hosseini and Kaneko, 2011). The definition by the Brudtland committee suggests three important components of sustainable development and these are: 1) what is to be sustained, 2) what is to be developed, and 3) the intergenerational components. Components that need to be sustained include nature, life support systems and communities. Those components that need to be developed involve people, society and economy whilst the intergenerational components are the finite nature of the earth resources which can provide intergenerational equity. (Arman et al., 2009 and. Anderson et al., 2012).

The three dimensions of sustainable development have been identified as (1) the social (2) the economic and (3) the environment (The North American Environthon, 2014). "Building on the longstanding work of the UCLG Committee on Culture and UNESCO's Universal Declaration on Cultural Diversity (2001) and Convention on the Diversity of Cultural Expressions (2005), the Executive Bureau of United Cities and Local Governments agreed at its meeting in Chicago (April 2010) to mandate the Committee on Culture to develop a Policy Statement on Culture as the Fourth Pillar of Sustainable Development (www.agenda21culture.net).

The AIA BEST PRACTICE (2008) defines construction waste management as "the practice of minimizing and diverting construction waste, demolition debris, and land- clearing debris from disposal and redirecting recyclable resources back into the construction process is commonly referred to as construction waste management (CWM).

Waste management affects carbon reduction efforts by impacting one or more of the following:

- **Energy consumption** (specifically, combustion of fossil fuels) associated with manufacturing, transporting, using, and disposing the product or material that becomes a waste.

- **Non-energy-related manufacturing emissions**, such as the release of carbon dioxide when limestone is converted to lime (which is needed for aluminium and steel manufacturing).

- **Methane emission from landfills,** It is estimated that anywhere from 25 to 40 percent of the national solid waste stream is building-related waste and only 20 percent of construction waste or demolition debris (C&D) is actually recycled. In 1998, the U.S. Environmental Protection Agency

Disposal of buildings in most industrial and emerging industrial countries is considered to be wasteful and problematic. Waste from building demolition (partial demolition for renovation, or total demolition for building removal) represents 30-50% of total waste in most of these countries (Kibert, 2003) Therefore *deconstruction* is proposed as an alternative to demolition. "It calls for buildings to be dismantled or disassembled and for the components to be reused or recycled" (Kibert, 2003). However, in a developing country like Ghana, it is expected that strategic waste management would call for a combination of several approaches

which support waste management throughout the construction process. The three well known approaches are the 3-Rs: Reduce, Recycle and Re-use (e.g. Resource Venture, 2005). The last part is possible only when deconstruction is possible.

The guide provides two main reasons for this approach:

- Cost reduction

- Market Opportunity.

The USEPA (2000) outlines the following benefits of recovering construction and demolition materials

- Reduces the environmental effects of extraction, transportation, and processing of raw materials.

- Reduces project costs through avoided disposal costs, avoided purchases of new materials, revenue earned from materials sales, and tax breaks gained for donations.

- Helps communities, contractors, and/or building owners comply with state and local policies, such as disposal bans and recycling goals.

- Enhances the public image of companies and organizations that reduce disposal.

- Conserves space in existing landfills.

The waste hierarchy has been identified as (Draft, 2011):

1. Waste prevention
2. Re-use
3. Recycle
4. Energy Recovery
5. Disposal

## 1.2 Problem Statement

The proliferation of Real Estate Development companies and the continuous construction activities by the government in the quest for infrastructural provision has left in its wake the relative depletion of natural resources and inevitable environmental problems in the country. Despite this obvious phenomenon, there is no concerted effort by the country to research into ways of managing construction waste. This brings to the fore the concept of sustainable construction within the Ghanaian construction industry. A call by Ms. Sherry Ayittey, one time Minister of Environment, Science and Technology (GNA, 2012) for the pursuit of initiatives that would promote sustainable production and consumption of renewable and non-renewable resources was timely.

A visit to most construction sites in Ghana reveal wastes in all its forms i.e. nails lying about; timber props and boarding left unpacked, cement slurry from placed concrete having dripped unto the floor below etc. Ayarkwa and Adinyira (n.d.) reports of a wide variation in wastage rates of between 5% and 27% of total materials purchased for construction projects in Ghana. As construction is a locomotive sector of the national economy, waste in the construction industry affects the overall national economy. These could have a serious impact on the environment. The cyclical effect on the industry in particular and on the country in general could be enormous.

## 1.3 Aim

The aim of the study is to investigate into the construction activities and practices in Ghana as a means of identifying the various construction wastes and to propose a framework by which sustainable construction management can be strategically achieved in Ghana.

## 1.4 Objectives

The following objectives were identified to be of paramount importance in achieving the aforementioned aim:

1. To identify the major types and forms of construction wastes generated during construction activities.

2. To assess the extent to which the existing ways of wastes management practices across the construction phases in Ghana considers sustainability.

3. To identify the most strategic means by which sustainable waste management could be achieved in the Ghanaian construction industry i.e. the application of reduce, recycle, and re-use across the construction phases.

4. To develop a framework for the diffusion of SCWMS in the Ghanaian construction industry.

## 1.5 Research Question

The following research questions shall guide the study:

1. How are construction wastes being managed in Ghana?

2. What are the problems associated with construction waste management in Ghana?

3. How can sustainable construction waste management be implemented in Ghana?

### 1.6 Scope

This study examines the extent to which sustainable construction and waste management strategies have been adopted by the construction industry in Ghana.

### 1.7 Research Programme (Work Packages)

### WP1. Review of sustainable construction and waste management strategies (6 months)

The objective of this work package is to conduct a comprehensive review of the literature on Sustainable Construction and Waste Management Strategies. A further aim is to identify knowledge gaps in the available data.

### WP2. Identification of the Sustainable construction wastes management practices in Ghana. (4 month)

The objective of the work package is to assess the extent to which sustainable construction waste management is being practiced in Ghana and the problems associated with it.

### WP3. Identification of Strategic Means of implementing sustainable construction and waste management strategies in Ghana. (8 months)

The objective of the work package is to identify the factors that define sustainable construction as well as waste management strategies. The analysis will also provide information on how to include sustainability and waste management strategies in the construction activities of the Ghanaian construction industry.

### WP4. Developing a framework for strategic sustainable construction waste management practices (1 year)

The objective is to use all the findings of the study as a basis for developing a framework by which strategic sustainable waste management can be practiced in the Ghanaian construction industry. It will bring to the fore the levels of adoption and actual implementation by the respondents.

### References

N. Zainul Abidin, "Investigating the awareness and application of sustainable construction concept by Malaysian developers," Habitat International, vol. 34, no. 4, pp. 421–426, Oct. 2010

J. Gutberlet, Recovering Resources - Recycling Citizenship: Urban Poverty Reduction in Latin. America: Ashgate Publishing, Ltd, 2008.

B.-G. Hwang and Z. B. Yeo, "Perception on benefits of construction waste management in the Singapore construction industry," Engineering, Construction and Architectural Management, vol. 18, no. 4, pp. 394–406, 2011.

Polat, G. and Ballard, G. (2004). Waste in Turkish Construction - Need for Lean Construction Techniques.

Proceedings of the 12th Annual Conference of the international Group for Lean Construction IGLC-12, August, Denmark. 488-501

Pheng, L. S. and Tan, S. K. L. (1998). How 'Just-in-Time' Wastages can be quantified: Case Study of a Private Condominium Project. Construction Management and Economics, 16: 621-635.

H. M. Hosseini and S. Kaneko, "Dynamic Sustainability Assessment of Countries at the Macro Level: A Principal Component Analysis," *Ecological Indicators*, Vol. 11, No. 3, 2011, pp. 811-823

N. Arman, J. Zuo, L. Wilson, G. Zilante and S Puller, "Challenges of Responding to Sustainability with Implications for Affordable Housing," *Ecological Economics*, Vol. 68, No. 12, 2009, pp. 3034-3041.

M. W. Anderson, M. Tiesl and C. Noblet, "Giving Voice to the Future in Sustainability: Retrospective Assessment to Learn Prospective Stakeholder Engagement," *Ecological Economics*, Vol. 84, 2012, pp. 1-6.

www.fgould.com/uk-europe/articles/sustainable-costruction-and-waste-management

www.ghanaherald.com/ghana-renews-efforts-to-tackle-housing-deficit