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Original Article

Factors affecting Industrial Attachment Programme: Measures of academic performance and efficiency in Zimbabwe: A Review

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Abstract

Assessment of the Industrial Attachment Programme was deemed incomplete without reviewing measures of academic performance, efficiency, and the factors that affect performance and efficiency. The factors forming the basis for this review were found to human and system oriented. Academic performance of students has to be measured using examinations, tests, assignments and exercises. Data Envelope Analysis and Stochastic Frontier Analyst were the efficiency measures reviewed. Data Envelope Analysis was regarded appropriate for this study considering its ability to handle multiple inputs and outputs. Data Envelope Analysis estimates allocative, technical and economic efficiency which are key efficient measures. Some of the factors reviewed include financing, timing, evaluation and assessment methods of the programme. Linkage among students, tertiary education institutions, host organizations and various stake holders were other key factors. Courses covered before Industrial Attachment were noted as other key factors since the programme intends to marry theory learnt in the classroom with the practice. Industrial Attachment in Zimbabwe as with the Agricultural colleges and other institutions of tertiary education was also reviewed. The institutions use different approaches which will help much in the assessment of the programme. Measurement of performance and efficiency levels were found to be done with primary and secondary schools making reference to the academic side and not much was found to be done with agricultural colleges and the industrial attachment programme thereby forming the basis for this study. Colleges have to adopt models which improve performance and efficiency of the programme.

Key words: Industrial Attachment, Data Envelop Analysis, efficiency, performance.

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1. Introduction

The rampant global adoption of the Industrial Attachment Programme by institutions of tertiary education as a training methodology has triggered the need to assess the performance of students and efficiency of the IAP. Its adoption is in line with the educational reforms mooted from the middle age to date from classical to Progressivism and or Reconstructionist approach. Clark and Jain (2013) indicate that classical education movement was first developed by Martianus Capella advocating education based on traditions for the western culture embracing the study of literature, poetry, drama, philosophy, history, art and languages in the 18th and 19th centuries. George (2012) reported industrial attachment as a pre-professional programme, which was a result of education reforms from classical to Reconstructionist approach from the 20th century (Ari, 2014). Graham (2015) describes industrial attachment as born out of progressivism where progressive education as a pedagogical movement which began late in the 19th century persisting in various forms to date. By contrast with classical (Euro-American), most progressive education programmes emphasised learning by doing, hands on, strong emphasis on problem solving, understanding and action as opposed to rote knowledge, projects and production. Cuban (2015) and Hughes (2015) put it rightly as de-emphasis on text books in favour of varied learning resources putting emphasis on lifelong learning and social skills for societal transformation (Yoko, 2010; Snyder, 2015). Since ever, industrial attachment was adopted in the Zimbabwean set up, especial the agricultural sector without measuring performance and efficiency levels.

Musemwa et al. (2013) reported the need for programme assessment to effectively allocate resources, for identification of best and poor practice and target setting. Monitoring efficiency changes over a specific period, rewards for good performance and good planning are some of the merits for programme assessment. It is the quest for each manager to produce the best in terms of quality and the most in terms of quantity from the least resources availed to become relevant to the organization (Simar and Wilson, 2000). Industrial attachment programme run by institutions of tertiary education including agricultural colleges in Zimbabwe needs to be run with sound management in addressing the points mentioned above to improve on effectiveness and efficiency for

sustainability. Measures of academic performance, measures of efficiency, factors affecting efficiency of the IAP and the IAP in Zimbabwe focusing at agricultural colleges and other tertiary education institutions are key areas reviewed in this paper.

Since the industrial attachment is assessed with scores attached to performance in various prescribed areas and it being affected by the theory learnt in the classroom, measures of academic performance were deemed necessary to be reviewed. The measures of academic performance include examination (practical and theory), tests assignments and exercises. Tarusikirwa et al., (2003) reported that these are scored for the purpose of measuring individual or group performance. The industrial attachment and the theory learnt in the classroom require a certain level of performance for accreditation or certification which can only be obtained through measuring performance using the internationally accepted measures of academic performance. Students in agricultural colleges cannot be spared from being assessed using such measures for authenticity of the accreditation at various levels and overally.

Efficiency of the IAP like any other programme or organization consists of technical, allocative and economic efficiency among other types of efficiency. Technical efficiency measures the ability of organizations to produce maximum output from a given set of inputs while allocative reflects the ability to choose the inputs in optimal proportions given their values. Economic efficiency refers to the extent to which waste or other undesirable features are avoided (Tremolet and Binder, 2010). The IAP for the agricultural colleges has to be assessed on technical, allocative and economic efficiencies with the view to improve on how the programme is implemented considering tertiary education institutions, host organizations, students and other stakeholders.

Clements (2010) highlights the perception of the host organization towards the programme, financing of the programme, nature of assessors and timing of the programme as some of the factors which affect the IAP (Hughes and Moore, 1999). These factors determine the level of success of the IAP in attaining the intended objectives depending on the attention given to them and the way they are addressed. Policy makers and implementers have to be aware of these factors in order to obtain

satisfactory results out of the IAP. Edziwa and Chivheya (2013) reported the relevancy of the place for attachment as one of the key factors for the student to have an opportunity to maximize the industrial attachment. Munyoro et al. (2016) emphasised the issue of employability and improvement of career prospects as factors of continuous assessment basing on job performance as outcomes of the industrial attachment programme. Increased output has to be recognized from the same level of inputs with the products of the industrial attachment program.

Assessment of the IAP cannot be complete without the measurement of its efficiency which include the Data Envelope Analysis (DEA), the Stochastic Frontier Analyst (SFA) and the Free Disposal Hull (FDH) as outlined, (Farrell, 1957). DEA was found suitable for this study following its ability to handle multiple inputs and outputs, being non-parametric and its compatibility with the Tobit model considered for the factors which affect student performance during the IAP (Coelli et al., 2005). The IAP was seen to be practiced in Zimbabwe by the agricultural colleges and other tertiary education institutions. These included teachers' colleges, vocational training centers, polytechnic colleges and universities. The Zimbabwe Republic Police (ZRP), Zimbabwe National Army (ZNA) and the Zimbabwe Nurses' Association (ZNA) have also their way of practicing industrial attachment internally apart from specializing in fields undertaken by other tertiary education institutions highlighted above.

It is therefore the gist of this review to focus on measures of academic performance, factors that affect efficiency of the IAP. The IAP in Zimbabwe covering the agricultural colleges and other tertiary education institutions will also be reviewed.

2. Measures of academic performance.

Academic achievement or performance is the outcome of education. It is the extent to which a student, teacher or institution has achieved their educational goals. Tarusikirwa et al. (2003) indicate that academic performance is commonly measured through written and or practical examinations and or tests, assignments, exercises which are regarded as continuous assessment. However, there is no general agreement on how it is best tested or which aspects are most important either procedural knowledge such as skills or declarative knowledge such as facts or both. Tests, exercises and assignments (continuous

assessment) are done in preparation for examinations where exercises cover a component of a topic, tests and assignments may cover a topic or more while examination is for a course and for certification.

Ward et al. (1996) and Tarusikirwa et al., (2003) concur in the measures of performance by indicating that responses to tests, assignments and examinations are scored for the purpose of measuring individual or group performances. In California, the Academic performance index is used to measure the achievement of schools where marks are allocated and classified or grouped coming up with a grading system depicted by symbols (A, B, C, D, E, O, and F), distinction, merit, credit, pass and fail. Classes are also used (1, 2.1, 2.2, 3 and fail) as measures of performance. Stumm (2011) added the element of units as a measure of performance with an array from 1 to 9. This is also adopted worldwide. It is this continuum of grades, classes and units which is qualified by a continuum of words (very poor, poor, good, very good and excellent. Performance before, during and after the IAP is a key indicator on the student, college and host's efficiency in the management of the IAP.

Performance during industrial attachment is a key determinant for the student's preparedness for the job market and therefore has to be measured. In this study assessment on how it is measured is also key since it determines efficiency of the system. Individual differences in academic performance have been linked to personality and intelligence. Students with higher mental ability as demonstrated by tests on Intelligent Quotient (IQ) and those who are higher in conscientiousness or thoroughness (linked to effort and achievement motivation) tend to achieve highly in academic settings. A recent meta-analysis suggested that mental curiosity has an important influence on academic performance in addition to intelligence and conscientiousness (Mahoney et al., 2005; Darling, 2005; Yeung, 2015).

In terms of academic performance there are a whole other group of variables to consider. Some of these variables include: demographic and familial influences, individual characteristics, program resources and content (Mahoney et al., 2005). Socio-economic status has been found to play a role in the number of students participating in extracurricular activities (Covay and Carbonaro, 2010). Furthermore, it is

suggested that the peer relationships and support that develop in extracurricular activities often affect how individuals perform in school (Eccles and Templeton, 2002). These are also practiced in agricultural colleges during their national sports gala normally held in the month of February each year. With all these variables to consider, it is very important to create a better understanding of how academic achievement can be seen in both a negative and positive light for sound improvement measures.

Assessment forms are designed to capture the performance during the attachment period. A pass/fail decision is made depending on the performance ratings on spelt out areas (Department of Agricultural Education and Farmer Training pass standards 2004). A lot of questions are raised on guidance by the academic institution, framework of awarding marks and if there is sufficient ground to measure the academic performance based on the time that is spent on attachment.

Tertiary educations institutions and their students cannot be spared from such factors and influential activities stretching to the management of the IAP. The variables highlighted need also a closer assessment basing on the review and experiences of the students, colleges and host organisations. Student assessment is done by different assessors from the host organization and college side with different levels of understanding of these factors and knowledge of areas for assessment resulting in significant variants in the scores. Weighting of the scores from the host organization and the college is skewed to the college which does spot visits for attachment which might not give a true reflection on performance and efficiency levels being experienced. Host organisations are not homogeneous which might advantage or disadvantage students.

3. Measures of efficiency.

3.1 Efficiency.

Tremolet and Binder (2010) reported that efficiency minimizes the waste of resources such as physical materials, energy and time, while successfully achieving the desired output. It is the ability to avoid wasting materials, energy, efforts, money, and time in doing something or in producing a desired result. In a more general sense, it is the ability to do things well, successfully, and without waste. In more mathematical or scientific terms, it is a measure of the extent

to which input is well used for an intended task or function (output). Efficiency, of course, refers to very different inputs and outputs in different fields and industries where in this case focus is on agricultural colleges in the Department of Agricultural Education and Farmer Training.

Efficiency signifies a level of performance that describes a process that uses the lowest amount of inputs to create the greatest amount of outputs. It relates to the use of all inputs in producing any given output, including personal time and energy. This calls for close monitoring and evaluation of the system to improve on efficiency and to improve any form of efficiency, one has to measure it first. Efficiency of the Industrial Attachment Programme run by the agricultural colleges and other tertiary education institutions can be achieved through minimizing wastage of the human, financial, material, capital and time resources allocated for the programme.

Tremolet and Binder (2010) suggested that a performance ratio used by many organizations such as banks, hospitals, government departments and local authorities. In cases where there is a single input and a single output, the efficiency in converting their inputs into outputs can simply be expressed as:

Efficiency = output / input

The ratio of useful output to total input is regarded as efficiency which can be expressed mathematically as r =P/C where P is the amount of useful output produced per the amount of input C (cost of resources consumed), (Tremolet and Binder, 2010). This shows that efficiency is a measurable concept that can be determined by establishing the ratio of useful output to total input. For the industrial attachment under study, there is need therefore to determine the input and the output in order to measure its efficiency. Efficiency is an important attribute because all inputs are scarce. Time, money and raw materials are limited, so it makes sense to try to conserve them while maintaining an acceptable level of output or a general production level, Tremolet and Binder (2010) indicate some forms of efficiency as economic, technical and allocative, to mention some. These forms have measures which might be different or similar depending on the factors considered though the bottom line is the relationship between the input and the output.

3.1.1 Economic efficiency

The economic efficiency is measured by the global economic performance of the firm, that is, by its ability to make its operations profitable. Farrell (1957) defined the economic efficiency by the product of technical efficiency and the allocative efficiency. According to his example, it appears that a firm cannot be 100% efficient economically if it is not 100% efficient technically and at the same time 100% efficient allocativelly. The economic efficiency can be separated into two distinct criteria and is therefore only the resultant of those two measures. As it is shown by Coelli et al., (2005) and Ajibefun and Daramola, (2003) this definition seems to be accepted universally. This refers to the optimization of resources in order to best serve each person in that economic state. There is no specific threshold that determines the efficiency of an economy but indications include goods and services being produced at the lowest possible cost and labour being performed with the greatest possible output. In other words, it is the extent to which waste or other undesirable features are avoided. Economic efficiency as an aggregate performance measure of an economy, the industrial attachment programme should be seen to prepare and contribute significantly to such levels as the GDP for economic turnaround. Colleges and firms as Decision Making Units working in collaboration should address the optimisation of resources to best serve the various categories of consumers for economic growth through the provision of goods and services as per consumer expectation (Wautabouna, 2012). The industrial attachment programme in the agricultural set up, especially for Zimbabwe has to economically efficient since agriculture is one of the economic factors which led to Zimbabwe losing its Bread Basket status for Southern Africa. Students on attachment have to be monitored especially the productive sector for quality management than denying them access to expensive and sensitive technology (Edziwa and Chivheya, 2015).

3.1.2 Allocative efficiency

Rodriguez-Alvarez et al. (2007) reported that the allocative efficiency puts in relation the inputs utilizations by the enterprise according to the current prices on the market. The allocative efficiency is necessary if the firm maximizes its profits or minimizes its costs at a given level of production. This is another form of

efficiency referring to the optional distribution of goods and services. This is quite critical when agricultural colleges and other tertiary education institutions distribute resources for the IAP, especially the student fees, vehicles, fuel and the human resource for student follow up and other administrative issues. Munyoro et al. (2016) noted the absence of a unit to coordinate the industrial attachment programme, fostering closer liaison with the industry, monitoring quality assurance procedures, carrying out regular reviews of the attachment programme in line with the changing and challenging environments, no vehicles allocated specifically for industrial attachment programme, absence of a specific budget for the programme, follow up visits given last preference in allocation of resources leading to some students completing attachment unassessed by the college. This is happening in the agricultural colleges and calls for immediate address to improve on the allocative efficiency and general management of the programme.

3.1.3 Technical efficiency

Technical efficiency measures the way that a firm chooses the quantity of inputs that is used in the production process for maximum output. Lovell (1993) defines technical efficiency as the efficiency of a production unit in terms of a comparison between observed and optimal values of its output and input. The comparison can take the form of the ratio of observed output to maximum potential output obtainable from the given input, or the ratio of minimum potential input to observed input required to produce the given output. In these two comparisons the optimum is defined in terms of production possibilities. Koopmans (1951) suggested a definition of technical efficiency by indicating that an input-output vector is technically efficient if, and only if, increasing any output or decreasing any input is possible only by decreasing some other output or increasing some other input. Watkins et al. (2014) suggested a measure of technical efficiency in rice production in line with other studies done with hospitals and banks. Musemwa et al. (2013) had measures of Technical Efficiency on farm set ups for Mashonaland Central Province. In all the scenarios, technical efficiency was measured to assess how well the available minimum inputs were used for the production of maximum outputs in service delivery and crop yields. Nothing was done specifically for the agricultural colleges where costs of student follow ups in terms of vehicle hire, fuel staff allowances and communication

can be considered as inputs while number of students assessed and student performance can be regarded as outputs. The farms, hospitals and banks are of relevance since students are attached in these areas.

3.2 Measuring Efficiency

In general, measuring of efficiency should be viewed in terms of how an organization uses its resources, such as available funding and staff, to achieve organizational objectives. It is applying these resources in such a way as to maximize their contribution to organizational outputs that is the goods and services it provides (Sherman, 2013).

Sherman (2013) presented six efficiency measures which are per unit costs, cycle time, response time, backlog, per unit full time equivalents and staffing ratios. Per unit costs reveal resources consumed in producing a unit of service and cycle time measures the time taken to complete a process. On the other end, response time measures time taken to respond to a request for service. It is regarded as a key measure of customer satisfaction as it indicates how much "waiting or queue-time" customers wait for a service response. In addition, backlog measures the amount of work in queue, waiting to be processed. One way is to measure total work in queue waiting to be processed. Another way is to measure backlog as the amount of work not processed within a required or targeted time frame**.** Per unit full-time equivalents (FTE's) measures how many employees are required to fulfill a unit of work and staffing ratios through computing a ratio of staffing to a particular function or in comparison to the total organization.

These efficient measures will be considered in this study looking at how best they fit and address the assessment of the IAP. In this regard, it may mean consideration of some and not all depending on how they address the focus of the study.

3.3 Measuring efficiency of service provision

Tremolet and Binder (2010) reported that the specific types of measures used by an organization may vary depending on its operations, goals and objectives. Ideally, these measures should be linked to an organization's quantifiable objectives and performance standards. Agricultural colleges have quantifiable objectives and performance standards to be linked with the measures of efficiency which are not currently in place. Services are provided

efficiently when they are provided at a fair and reasonable price for all consumers while allowing the supplier to cover the incurred costs and get a fair return on its investment. It is noted that efficiency is important in keeping costs down, reducing dependence on government assistance and freeing resources for business expansion and maintenance (Shirley and Ménard, 2002). This aspect of reducing dependence on government subsidy and freeing resources for investment is a major concern in assessing efficiency of the attachment programme since the institutions under study are government owned.

Core Overall Performance indicators include specific core indices, such as volume billed per worker, quality of service, losses, coverage and financial data. These measures are generally available and provide the simplest way to perform comparisons. However, such indicators are by definition partial that is they examine a series of performance dimensions and do not allow to take interactions and the overall picture into account and may fail to account for the relationships among the different factors (Berg and Padowski, 2007). These were seen not to address the aspect under study and the issue of core overall performance will not be used to quantify variables, however can be used in other studies.

Performance Scores (based on production or costs estimates) is the metric approach allows quantitative measurement of relative performance (cost efficiency, technical efficiency, scale efficiency,
allocative efficiency and efficiency change). Performance can be compared with other utilities and rankings can be based on the analysis of production patterns and cost structures (Berg and Padowski, 2007).

3.4 Efficiency measures involving a comparison with the most efficient frontier.

Lovell, 1993 defines the efficiency of a production unit in terms of a comparison between observed and optimal values of its output and input. The comparison can take the form of the ratio of observed to maximum potential output obtainable from the given input, or the ratio of minimum potential to observed input required to produce the given output. In these two comparisons the optimum is defined in terms of production possibilities (frontiers), and efficiency is technical (Koopmans, 1951).

The allocative efficiency in economic theory measures a firm's success in choosing an optimal set of inputs with a given set of input prices; this is distinguished from the technical efficiency concept associated with the production frontier, which measures the firm's success in producing maximum output from a given set of inputs. In this regard, understanding on measurement of efficiency using various approaches will help in either choosing one or combining them for best results and sound decision making in the management of the IAP.

Among its several useful properties, one of the most important is the fact that the reciprocal of the direct input distance function has been proposed by Debreu (1951) as a coefficient of resource utilization, and by Farrell (1957) as a measure of technical efficiency. This property has both a theoretical and a practical significance. It allows the direct input distance function to serve two important roles, simultaneously. In this regard, it provides a complete characterization of the structure of multi-input, multi-output efficient production technology, and a reciprocal measure of the distance from each producer to that efficient technology.

Linear programming theory is a milestone of efficiency analysis. Charnes and Cooper (1961) made considerable contributions to both theory and application in the development of linear programming, and popularize its application in Data Envelope Analysis (DEA) in the late 70s (Charnes et al., 1978). The use of linear programming and activity analysis can be found in the work of Leontief (1941, 1953) who developed a special case of activity analysis which has come to be known as input-output analysis.

By enveloping data points with linear segments, the programming approach reveals the structure of frontier technology without imposing a specific functional form on either technology or deviations from it. It is one of these characteristics of DEA which makes it suitable for this study. Frontier technology provides a simple means of computing the distance to the frontier - as a maximum feasible radial contraction or expansion of an observed activity. This explanation is consistent with Debreu's coefficient of resource utilization and with Farrell's efficiency measures. (Debreu, 1951; Farrell, 1957)

3.5 The economic model

Measuring efficiency for any data set of the economic model requires first to determine what the boundary of the production set can be; and then to measure the distance between any observed point and the boundary of the production set. Given a list of p inputs and q outputs, in economic analysis the operations of any productive organization can be defined by means of a set of points, Ψ, the production set, defined as follows in the Euclidean space Rp+q + : Ψ={(x,y)| x ∈R p +,y∈R q +,(x,y) is feasible}, where x is the input vector, y is the output vector and "feasibility" of the vector (x,y) means that, within the organization under consideration, it is physically possible to obtain the output quantities y1,...,yq when the input quantities x1,...,xp are being used with all quantities being measured per unit of time.

Simar and Wilson (2001) pointed out that no behavioural assumptions are necessary for measuring technical efficiency. From a purely technical point of view, either the input or the output distance function can be used to measure technical efficiency-the only difference is in the direction in which distance to the technology is measured. The way of looking at the frontier will typically depend on the context of the application. For instance, if the outputs are exogenous and not under the control of the Decision Makers (for example as in most of the public services), input efficiency will be of main interest, since the inputs are the only elements under the control of the managers. But even in this case, both measures are available.

Starting from the first empirical application of Farrell, several different approaches for efficient frontier estimation and efficiency score calculation have been developed. In these models, the attainable set Ψ is defined through a production frontier function, g(x, β), which is a known mathematical function depending on some k unknown parameters, that is β ∈R k, where generally y is univariate, that is y ∈R +. The main advantages of this approach are the economic interpretation of parameters and the statistical properties of estimators; more critical are the choice of the function (x,β) and the handling of multiple inputs and multiple outputs cases (Farrell, 1957).

3.6. Nonparametric Models.

These models do not assume any particular functional form for the frontier function g(x), (Farell, 1957). The main pros of this approach are the robustness to model choice

and the easy handling of multiple inputs and multiple outputs case, while their main limitations are the estimation of unknown functional and the curse of dimensionality, typical of nonparametric methods. This will suggest more of the need to use DEA in this research giving room for further studies in the areas considering the aspect of multiple inputs and outputs. The mainly used approaches in empirical works are the nonparametric (deterministic) frontier approach and the (parametric) stochastic frontier approach. The nonparametric frontier approach, based on envelopment techniques (DEA FDH), have been extensively used for estimating efficiency of firms as it relies only on very few assumptions for Ψ. The main nonparametric estimators available are the Data Envelopment Analysis (DEA) and the Free Disposal Hull (FDH).

3.7 Data Envelopment Analysis (DEA).

Data envelope analysis is a non-parametric method for the estimation of production frontiers. It is used to empirically measure productive efficiency of decision making units (DMU) when the production process presents a structure of multiple inputs and outputs. Musemwa et al. (2013) indicate that Data Envelope Analysis has the ability to incorporate technical parameters that may not be captured by parametric production efficiency methods and is capable of handling multiple inputs and outputs as highlighted above. It is also used for benchmarking in operations management, where a set of measures is selected to benchmark the performance of manufacturing and service operations (Cook et al., 2014). Non-parametric approaches do not assume a particular form or shape for the frontier however, they do not provide a general relationship (equation) relating to input and output. With the increasing use of DEA, in operation research and economics and its merits highlighted above, it is deemed necessary for its application in this research as well since it is designed to help in measuring and improving performance of organizations institutions of tertiary education targeted. The quest for greater efficiency is never ending as managers are always under pressure to improve performance of their organizations. Industrial attachment programme has to be managed with greater efficiency to produce maximum value out of the attachees, the production sector, host organizations and institutions of higher learning. In the public sector, governments are constantly seeking value for tax payers' money, while the

emergence of a more global economy has intensified competitive pressures on commercial companies who happens to be employers of graduating students following a year of industrial attachment.

The analysis compares the relative efficiency of organizational units such as bank branches, hospitals, vehicles, shops and other instances where units perform similar tasks as with agricultural colleges and host organizations. These units use similar resources referred to as inputs to generate similar outputs, however there could be considerable differences in the way in which individual units combine these inputs to produce outputs. There may be also differences in potential caused by the technology they have, geographical location and catchment population where institutions of higher learning are not spared of this phenomena depending much on the year of establishment.

DEA allows one to take account of all the important factors that affect the organization's performance to provide a complete and comprehensive assessment of efficiency. It does so by converting the multiple inputs and outputs in a single measure of productive efficiency. It offers various ways of visualizing the results and shows in detail which units are performing the best and why they are doing so. These will help either in the review or formulation of a sound IAP policy focusing on efficiency to produce competent cadres from minimum inputs. Mbanga (2000) noted that many organizations such as banks, hospitals, airlines, government departments and local authorities uses the DEA to perform a number of tasks which include resource allocation, relocating from the inefficient to the efficient, identification of best and poor practice, target setting, monitoring efficiency changes over time and rewards for good performance. This qualifies the DEA for analyzing the data for this specific study.

DEA was rated best by other researchers assessing efficiency of government departments, hospitals and banks (Mbanga, 2000). This is in line with the study being under taken. It has the ability to incorporate technical parameters that may not be captured by parametric models (Coelli et al., 2005). Therefore use of DEA in undertaking an efficiency study for the industrial attachment programme for agricultural colleges in the Department of Agricultural Education and Farmer Training is relevant and results will however benefit all

institutions of higher learning which practice industrial attachment as a training methodology. It is critical to define and select the units to use in the analysis, decide which factors to use for inputs and outputs and analyze and interpret the results.

The DEA estimator of the production set initiated by Farrell (1957) and operationalized as linear programming estimators by Charnes et al. (1978) assumes the free disposability and the convexity of the production set Ψ. It involves measurement of efficiency for a given unit (x, y) relative to the boundary of the convex hull of X = {(Xi, Y i), i=1,....,n}:

ΨDEA = (x,y)∈R p+q + | y ≤ n i=1 γiYi;x ≥ n i=1 γiXi, for (γ1,...,γn) s.t. n i=1 γi = 1;γi ≥0,i=1,....,n (Farrell, 1957).

ΨDEA is thus the smallest free disposal convex set covering all the data. The ΨDEA allows for Variable Returns to Scale (VRS) and is often referred as ΨDEA−V RS (Banker, Charnes and Cooper, 1984). DEA by the nature of handling multiple inputs and outputs appears to be the best among other data processing methods/ package in assessing efficiency of the Industrial Attachment Programme for agricultural colleges in Zimbabwe and therefore will be adopted for this study. The measures were found not directly used in colleges but in host organisations where these students get attachment such as farms, schools, banks and hospitals. These provided good models for measuring efficiency which can also be applied in the agricultural colleges for best results towards the improvement of the industrial attachment.

4. Factors which affect efficiency of the Industrial attachment programme.

The efficiency of the Industrial Attachment Programme also consists of technical, economic and allocative efficiency. These various types of efficiency are aligned with factors affecting and some might be found crosscutting.

To effectively guide policy makers, host organizations, students, directorate and colleges, it is critical to identify factors that affect the efficiency of the Industrial attachment programme. Factors that affect the success of the Industrial Attachment Programme which include evaluation/ assessment methods employed, relationships of students with co-workers and seniors of the host company and college lecturers. Costs attached to the IAP and linkages among the students, college and the host are

some of the factors. Hughes and Moore, 1999 adds to the factors by indicating that, perception of the host organization towards industrial attachment, financing of the programme, nature of assessors (from the college and host organisations) and timing of the programme affects efficiency of the industrial attachment programme (Clements, 2010). Punia (2013) noted specific human oriented factors such as motivation, attitude, emotional intelligence, support from management and peers, training style and environment, open-mindedness of trainer, job related factors, self-efficacy and basic ability where special attention should be paid for efficiently run industrial attachment programme.

King (1994) indicates that, courses covered before going for attachment impact a lot on efficiency of the industrial attachment programme since they complement each other. Edziwa and Chivheya (2013) pointed out that for a student to maximize experiential learning during farm/industrial attachment, it is imperative that the place of attachment be relevant to the needs of a student's programme. This encompasses nature of activities at the place, technology that is in synch with current trends and appropriate mentorship.

Mentorship in this regard can be regarded as key since it requires personnel that has requisite knowledge and skills in the field of study and the ability to coordinate various resources towards the organizational goals. This sub topic being a component under study, more factors will be unearthed with possible measures to address them for more gains specifically on Agricultural colleges together with other institutions which practice Industrial Attachment.

5. The industrial attachment programme in Zimbabwe.

5.1 Agricultural colleges (Department of Agricultural Education and Farmer Training).

Departmental operations are guided by the mission and vision given below as extracted from the Departmental strategic plan of 2010.

Mission:

Produce agricultural graduates capable of delivering agricultural support services in practical farming, research, extension and farmer training.

Vision:

To promote the development of an efficient, competitive and sustainable agricultural sector that assures food security band

increased income through capacitating of farmers by way of availing adequate mechanization and irrigation facilities. The vision recognizes the need to strengthen and expand the emerging opportunities brought about by the land reform Program, and deals with the challenges facing the agricultural sector. This vision strives to contribute to the overall goal of poverty reduction and fulfilment of the millennium development goals.

Goals:

To provide youngsters, aspiring agriculturists, farmers and scientists with the right attitude, an appreciation of the importance of the sector, farming knowledge, skills and science in the practice of agriculture in order to:

- Provide entrepreneurial and adequately trained personnel capable of steering vibrant agricultural operations in order to achieve sustainable agricultural productivity nationally.
- Build and maintain a pool of skilled, competent and innovative core personnel, capable of meeting the diverse needs of various stakeholders such as producers, processors, marketers, researchers, administrators, planners and other agribusiness experts who drive the agricultural sector towards the attainment of its vision.
- provide short term training and education to farmers on identified problems and keep them abreast with current development in the sector.
- have agricultural colleges being centres of excellence in their respective localities.

Core functions

• Agricultural Education;

• Farmer training.

5.2 Historical background

The department of Agricultural Education and Farmer Training operated as a branch under the Ministry of Agriculture for years since the 1950s. It was elevated to departmental level in 2004 when its span of control was expanded from the traditional seven to fourteen (14) agricultural colleges till 2010 when the agreement elapsed following the training of the needed frontline officers that is certificate holders. (Training standards for agricultural colleges 2004, regulations for students in Agricultural colleges (undated) Director's

report, 2010 department of agricultural education and farmer training.

By then, the department ran fourteen colleges seven of which were being run in conjunction with the Ministry of Youth Development, Indigenisation and Empowerment in the training of students at certificate level under an apprentice program which was fully funded by government. This became necessary in order for the department to cope with the increased demand for front line personnel by the Department of AGRITEX after the inception of the land reform program as a measure to increase production and productivity. Since 2010, the department remained with seven (7) colleges namely Chibero, Esgodini, Gwebi, Kushinga Phikelela, Mazoe vet, Mlezu and Rio Tinto Agricultural colleges till 2011 when Shamva Agricultural College was opened in Mashonaland Central province to make them eight (8), (DAEFT annual report 2011).

6. Conclusion

From the review, efficiency of the IAP can be affected by the assessment and evaluation methods employed during the course of training, relationships of students with core workers, supervisors, owners of the host organizations and college lecturers. Perception of the host organizations towards the IAP, financing and timing of the programme were also other factors noted. Courses covered before going for the IA were also indicated to affect the IAP. Measures of academic performance such as examinations, tests, assignments and exercises were also covered together with the measures of efficiency which included the DEA, SFA and the FDH. The IAP in Zimbabwe covering the agricultural colleges and other tertiary education institutions was also reviewed. This was deemed necessary in addressing the assessment of the IAP under study.

Industrial attachment has been adopted by tertiary institutions in various continents and increasingly being adopted for its strengths in preparing students for the job market and marrying theory to practice in line with the Reconstructionist approach to education. It was noted that benefits and challenges are experienced in the process by various stake holders hence the need to assess the efficiency level within the department of agricultural education and farmer training using some of the analysis methods reviewed like the DEA.

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