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Modelling the Effect on Quality of Facilities Management in Higher Education in Reference to Egyptian Universities

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DEDICATION

To the memory of my dearest compassionate sacrificing mother

FATMA ELZAHRAA

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ABSTRACT

In order to rise nations, the comunit expectations form the system of higher education must fulfil regarding to the quality of the unnivercities‟ graduates depending on market needs. A good funding methiods should be adopted in oeder to enhancement of the performance-based management practices. Decisive actions need to be taken towards the realisation of national goals and the improvement of institutional responsiveness and system cost-effectiveness.

This research began with the critical review of all relevant literature that emphasizes the interplayed factors influencing the quality of education in universities and used modelling techniques for quality management in the educational sector. Universities‟s managerialization signifcally influnce the education‟s quality, which interested with the preface of significant amendments in the processes of decision-making administrating the institutions‟ academic, and the use of new information systems in alignment with new administrative methods to streamline the tactical organizational connections with its stakeholders.

The provision of facilities acts as the essiential element in selecting to apply to a specific university in students‟ perspective. Hence, Egyptian‟s Universities facilities were formed to create the measuring criteria for the influnce of Egyptian Higher Education institutions resources‟ regarding to education system context through enhancement the experience of student. A primary research was conducted by devising a questionnaire to evaluate the prominence of universities‟ facilities in accordance to he value that the universities consumed in the allocated financial budget. It was sent to the departments‟ heads of logistics and finance in Egyptian universities which divede into forty three universities, twenty of them are public and twenty-three are private, for the purpose of the criteria recognition of the most prevailing university's facilities that promote or create a value-add to the quality of education.

System Dynamics was selected as the appropriate modelling simulating tool for this exploratory study into better allocation of resources in facilities management. System Dynamics approach has been utilized in attaining excelled interpretation of the complex dynamic behaviour of education for achieving higher education systems improvements because of its ability to catch the influnce of long-term management policies. Based upon the regression analysis produced from the pilot questionnaire, a System Dynamics Model was constructed that includes the main facilities which most of the decision makers agreed on their significance.

The generic proposed model was evaluated by means of its public application‟s and another non public (private) univercity in Egyptian as a case study and ultimately it can be adopted on

the sector of education for the reason of enhenceing the education‟s perceived quality. After model assessment process, the best practice combination of budget used up by the facilities could be accomplished will resulting in increase of the quality of the service provided by means of comparing the effects of different budget assignments on the estimated quality. Thus, better strategies for facilities management are recognised through the thorough insight into the componenets‟ of facilities service that considered be most prioritised in importance considering its long-term impact on the perceived quality of the education system and its improvement in Egyptian universities. A set of recommendations are produced for the policy makers in Egyptian universities for better allocation of facilities with limited resources.

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND

The good educational services provided by universities have a significant and direct influnces on the graduates‟ career development. The management of any university academic resources considered one of the multifaceted complicated administrative problems. Managers need an effective supportive tool in order to evaluate and analyse then take the right decision for the adequate resources allocation in facilities management. Most higher education managers and policy makers use the classic analysis techniques such as SWOT analysis that is divided into four quadrants 'Strength', 'Weakness', 'Opportunity' and 'Threat' and other quantitative approaches like public accountability; performance based funding, unit cost budgeting for determining allocation of resources and budget distribution. The main problem with these approaches is the lack of system thinking.

Barry Richmond. (1987), stated that systems thinking can defined as the science and art of building credible implications about attitude out of the development of higher deep comprehension of implied basis (Richmond, 1994). Numerous studies such as Hopper & Stave (2008) stated that through many definitions by many researchers covering wide domain of topic‟s literature, combined items tend to contain linkages, the comprehension of the functional attitude, methods basis like a reason regarding to that attitude, and the suggestion of showing the whole methods instead of methods parts. This study will build a modelling tool for good management facilities that will result in improving universities perceived quality, and the developed model will established bases on dynamic system prospective. The case study in this research will focus on one public university and another private one in the Egyptian educational sector and the suggest tool in the model developed will be applied.

1.2 HIGHER EDUCATION QUALITY PERCEPTION

The national competitiveness in the modern age depending on the education quality that come down from the mixture of exceptional learning method and the audience satisfaction in the process of the delivery of the educational service (Hanasya, Abdullah, & Warokka, 2011). Generally, consumer satisfaction is the outcome of the service quality delivered (Zeithaml & Parasuraman, 1996; Zeithaml & Bitner, 2000). Many topics (Gwynne, Devlin, & Ennew,

2000), stated that there is a connection between the service quality and satisfaction regarding to the basic theory, and the execution measure method (Cronin & Taylor, 1994).

Consumer satisfaction remains the conclusive objective for all organisations including higher education section (Razavi, Safari, & Shafie, 2012). Quality perception had several dimensional (Gerson, 1993). Customers‟in the higher education segement considered as one of the stakeholder in, who is having many interests though the university (Moraru, 2012). The concept of higher education quality had many perspectives of stakeholders‟ point of view; for example, parents stated that education quality is denuding on schools‟ classification and universities‟ reputations, beside employment opportunities. In addition, students stated that the education‟s quality is depending on the taught subjects and the ways of teaching. While faculty members stated that educational quality, depend on the overall educational system, encompassing feed in and the results. Furthermore, the firms stated that quality of education are depend on the proficiency set, which the graduates transferee to the working environment. Educational Institutions can implementing various quality approaches like the European Foundation for Quality Management (EFQM), ISO 9000, Malcolm Baldrige National Quality Award (MBNQA), Singapore Quality Award (SQA), School Excellence Model (SEM), etc. to improve performance and strengthen the quality assurance mechanism followed (Woodhouse, 2011a) as will presented in the next chapter.

Middle of sixteenth, in United Kingdom and Ireland many external quality agencies was launched. In 1980, the expansion of the „quality revolution‟ of Deming, Crosby, Juran et al., and the expandable use of quality make its way into academia (Woodhouse, 2011b). There existed much argument over the denotation of the word „quality‟ in the 1990s, especially in higher education practice, and a group of alternatives‟ lists were generated. Few protagonists claim for a one meaning, whereas others favoured to utilize several meanings. Many researchers go for the statement that there occurs that quality meaning had nor aggrement (Harvey & Green, 1993). Quality Assurance (QA) demonstrates the behaviors, policies, procedures and actions that are very important to grantee the sustainability and enhancement of quality. The first „quality agencies‟, were established in the USA as professional associations perhaps as a result of the unfavorable historical national behavior related to the governmental monitoring. They are called accreditors (Neubauer, 2008).

The International Network for Quality Assurance Agencies in Higher Education (INQAAHE) began in Hong Kong in 1991 with the membership of a dozen of QA agencies. Recently, it

has about two hundred and thirty organisational members. Around one hundred and fifty of these quality agencies are found in nearly 80 countries. In 1999, the Bologna Process that was embraced by forty-seven European Nations aspired the reform of higher education in Europe out of the provision of quality courses and the recognition of smooth procedures (Ryan, 2010). INQAAHE aims to strengthen the collegial interaction, and to create a framework for ideas‟ share and better implementations. INQAAHE‟s concentrate on movements towards the development polices, interactions with other world agencies (such as OECD, UNESCO, World Bank), and the appraisal of quality agencies as a results of the growth of regional networks, which are concerned with practical guidelines and standards. A number of organisations were launched for the sake of QA function worldwide to involve the auditing of the European Universities Association (EUA), the Internationalisation Quality Reviews developed by the OECD, the European System for accreditation of management and business administration (EQUIS), the Central American Accreditation Council (CCA) and the former Global Alliance for Transnational Education (Woodhouse, 2011a).

To conclude, many researches have addressed the change in the quality perception of the university‟s education as a whole, and the university‟s role specifically. The Bologna Process and Lisbon Convention have defined a new perception of Quality in Education that relies on „student focused‟ educational service provision and thus, delivering an enhanced quality student experience. Part of these services is university „facilities‟ which are acknowledged as a key factor in the quality assessment of a university (Sahney et al, 2004). Little research exists in identifying the key drivers in the area of resource allocation for facilities at universities. There are many inter-related factors at play, which need assessment. One approach to explain these interrelated factors is System Dynamics, which has the advantage of dealing with „soft‟ variables and identifying derived consequences that could fully represent the dynamic behaviour of Higher Education (Kennedy and Clare, 2003; Oyo et al., 2008; Hussein, 2010; and Strauss and Borenstein, 2014).

1.3 SYSTEM DYNAMICS FOR BETTER DECISION MAKING

System Dynamics approach has been utilized to improve higher education systems. Frances et al. (1994) analysed the effect of budget on American higher education that was demonstrated first time through Houston‟s university. Dahlan and Yahaya (2010) presented a System Dynamics model for university amplitudes demonstaring via balancing the available capacities in the educational system consisting of lectures, facilities and students

enrollements. Policy items like facility distributions, approived policies, and monetary support were encompassed in their study. Barlas and Diker (2000) introduced a simulation model for the choosing of strategy in the systems of universities in order to solving thr problems of facultyand students, research productivity, and education‟s quality. Barnabe (2004) studied the reshape of the system higher education through the usage of System Dynamics approach due to its ability to capture the effect of long-term management policies. The model demonstrated that universities management system influences the teaching and research performance. Managerialization entails the blend of managerial knowledge and practice of influential aspiring logic while administrating organisations for the effective achievement of planned targets (Maier & Meyer, 2011; Cunliffe, 2009). Skribans et al. (2013) established a model to examine the evolution of universities with innovation and research centres. The outputs of the model showed a significance relationship between the developing capacity and the methods of pioneering technologies‟ innovative. Moreover, Strauss and Borenstein (2014) used a System Dynamics model as educational methods for the makers of decision to investigate the influence of numerous methods of improving higher education enrolment in Brazil. The studied variables in their model were supply, dermand, regulations, goals, and the stability between private and public segments and they compared the results of their simulation with real data for model validation.

1.4 RESEARCH NEED IN EGYPTIAN CONTEXT

The research will take place in Egypt (one of the biggest developing countries with a tremendous expansion in higher educational sector). Applying System Dynamics approach in Egypt‟s Higher Education system by using the development of a Dynamic Model would help Decision Makers in Universities to direct their financial resources towards the appropriate services, which is a worthy topic that could be of great significance.

In North Africa and the Middle East, Egypt considered one of the biggest educational system. For the purpose of improve the higher eduation; the Egyptian government give it its high priority because it will leads to competitive advantage internationally. This is being achieved through a series of extraordinary educational programs. As introduced in Bologna Process, he required change in higher education id done through quality assurance along with structural reforms to make sure that the accountability of higher education institutions rises to external expectations at national level and additionally strengthens the compatibility between different national quality assurance systems (Dale, 2007). The Egyptina Quality assurance program

depend on strictly accreditation programme and higher education institutions external quality assurance sysemt (Arab Republic of Egypt 2004; 2006; 2009). However, the external consultancy from the Quality Assurance Agency of the UK and conditions of funding from World Bank loans seem to affect the developments of quality assurance in Egyptian context.

In the past decades, Egypt has implemented a number of reforms with the assistance of external players like the EU and the World Bank. The Higher Education Enhancement Project (HEEP)7, a comprehensive reform program sponsored by the World Bank and the EU‟s Tempus Programme, was launched in 2002. These actions lead to a dramatic transformation of the Egyptian higher education scene, for the reason that such "imported" good practice and organisational schemes stimulated governmental efforts to set forth a strategy of quality enhancement (DAAD, 2012).

Formal mechanisms and institutions of quality assurance were established. Supreme Council of Universities is the principal accrediting body in Egypt, which establishes the rules for Bachelor, Master and Doctorate programmes. The Credit Hours System generally employed by most programmes that is calculated in reference to the British/American system. Since 2002, a change has occurred in the quality assurance system for HE universities and institutions to include the system of internal QA that results in an institutional annual report defining all quality components directed to the completely academic programs. As well as an external quality evaluation and accreditation phase through the National Authority for Quality Assurance and Accreditation of Education (NAQAAE), an independent agency established in 2010, that defines the Academic Standards and Procedures of accreditation for all programs in the Higher Education system, which became obligatory for each HE institution including faculty, higher institute, and technical college.

Each university embraced procedures for its internal QA in which the academic staff gets engaged in a decision-making role (EACEA, 2012a). One of the main issues with state-controlled quality regimes in the Middle East & North Africa is that their deliberation lies in the higher education rapid quantitative growth in order to meet the demand increase; and always associate quality with accreditation (Hassan, 2013).

The Tempus Programme was taken place successfully in Egypt and was widely supported in academic circles, due to its authorization given to university staff members to contribute with their own thoughts into the reform process (EACEA, 2012a). Tempus managed to get ahead the "flavour of the Bologna process in the system, stated that Egypt is not a signatory country

and even efforts performed in order to apply the three-cycle structure of Bologna style collapsed (EACEA, 2012b). Several trials have been made in the framework of Tempus cooperation projects to can find a solution for the gap between universities and the labour market; relatively the most significant achievement is the launching of competitiveness standards through curricula modernisation (Králiková and Rezk, 2012). The introduction of a culture of projects and the implementation of a National Qualifications Framework have additionally allowed Egyptian universities to go forward on a path of international recognition and to get involved in different forms of cross-border cooperation with European institutions, including the establishment of joint programmes and degrees (EACEA, 2012a). Furthermore, Egypt has started defining equivalencies between its own credit system and ECTS (European Credit Transfer System) to make the design of "European oriented" study programmes more easier (European Commission, 2012). Moreover, Learning outcomes, a new internationalised European concept connecting individual skills and the knowledge economy, that was introduced in certain disciplines as part of a World Bank/OECD project called AHELO8 (Assessment of Higher Education Learning Outcomes). This project aimed at the evaluation of the students‟ skills acquired during their period of study through the testing of meaningful indicators of learning outcomes, where such assessment is essentially needed in Egypt as thousands of graduates find themselves unemployed each year.

However the higher educational sector in Egypt has been dedicated to the path of regular renovation, efforts are becoming higher and higher determined on the assessments of aspects in reference to economic competitiveness. Besides, researchers showed that the "social bias" of Egypt public higher education sector was not picked out via the reforms (Jaramillo & Melonio, 2011). Regional disparities are constantly regenerated regardless of the increase of governmental investment in higher education and obviously fair conditions of access (no tuition fees) is financially unsustainable situation and as well as socially undesirable (Jaramillo & Melonio, 2011). With the population increase in Egypt, higher education acts as a fundamental player in sustaining the social balance (LaGraffe, 2012); external efforts are still unable of generating an operational employability notion on reality for the development of meaningful principles in quality of education.

In 2012, Cairo considered one of the highest score for „affordability‟ regarding to QS Best Student Cities, and Mexico City is the closest city to Egypt. Nevertheless, the higher costs remain an important factor for most students; thus Egypt‟s condiered on of that most wanted destination regrading to higher education. Education in Egypt has been free at public

institutions since 1962, and is obligatory till the end of the first phase of secondary school, i.e. up to the ninth year. Five Egyptian universities have been included in the 2014/15 Quality Standards QS World University Rankings. The five universities were the American University in Cairo at 360th in the world, Cairo University (551-600), Ain Shams University, Al-Azhar University and Alexandria University. In addition, the facilities availability considered an important factor in selecting to apply to a specific university in accordance to students. These facilities include libraries, security, computer labs, classrooms, health care, and other premises. The biggest amount of university funds is often allocated for the process of improving and maintaining students‟ facilities.

There was forty-six universities in Egypt, twenty of them are public (with about two million students) and twenty-three are private (60,000 students). In the year 2013/14, Egypt had about 1,900,000 graduates from public universities and about 10,000 graduates from private ones. In the year 2009/10, about 80.3% of high school students applied for higher education. This was considered a high rate compared to a 65.9% in USA and a 50% in the UK. These statistics demonstrate how investigating on higher education in Egypt will postulate reliable results worldwide.

This research started by addressing a questionnaire to the presidents of Logistics and Financial Departments in (twenty-three private universities) and (twenty domestic universities) in Egypt via mail to ask them about the importance ranking of facilities and their financial Budgets. Based upon the regression analysis produced from the questionnaire, a System Dynamics Model was constructed including the main facilities that most of the decision makers agreed on their significance. The data concerning universities facilities was collected in reference to the two foremost universities (Arab Academy for Sciences and Technology, and the Alexandria University) due to the reason that they are both located in Alexandria targeting same market segment. The availability of collected data was acquired through ISO and quality assurance records. After the assessment of the model, the Best Practice combination of Budget spent on the facilities could be achieved leading to the increase of the service quality provided.

1.5 RESEARCH AIM

This research will address the knowledge gap regarding the causal and dynamic effects of facilities management on the overall effectiveness and appeal of a university, which this research will address. The purpose of this study is to extract the knowledge gap relating to the

influence of facilities management on the quality of university education using an Egyptian case study. This study aims to develop a system model that investigates the connection between the the universiyt‟s education quality and resource distribution in the educational Egyptian sector. The model will provide a management tool to help decision-makers in universities to better allocate their budget for facilities resources to achieve enhanced student experience and correspondingly value-added quality of education.

1.6 RESEARCH OBJECTIVES

1. To prepare a literature review to explore the followings:
   - Existing models of Quality Management for Universities with particular reference to situation in Egypt;
   - Decision Support Systems used for resource allocation in HE to rationalise the selection of System Dynamics as the appropriate modelling simulating tool for this exploratory study into better allocation of resources in facilities management.
2. To analyse the physical facilities in Egyptian Universities and accordingly establish criteria for measuring the impact of the resources provided by Egyptian HE institutions in the field of the education quality over the enhancement of student practice.
3. Prepare a model to act as a strategic management tool for the decision makers in Egyptian educational sector to better allocate resources and budget distribution, in reference to the above conducted research of how an Egyptian university's infrastructure and its facilities impact on the education quality provided to students and consequently their retention potential.
4. To evaluate the proposed model via its application on a public Egyptian University as the modelling structure and another private Egyptian University as a case study and eventually envisage that the model can be adopted on the educational sector in general to enhence the perceived quality of education.
5. To provide a set of recommendations from the resulting trial scenarios of the integrated model of the combined influential six service facilities for resource allocators that can be presented to the Egyptian Ministry of Education to draw an successful policy to follow of the good use the limited funding available for allocating resources in Egyptian Universities.

1.7 RESEARCH PLAN

The research plan that related to the proposed research objectives was practised in the following stages:

Stage One

Critically review all relevant literature that emphasizes the interplayed factors influencing the quality of education in Universities and the used modelling techniques for quality assurance in educational sector. This is attained through searching different academic databases for papers, reports and e-books on the preceding mentioned topics.

Examine the current Decision Support Systems used for resource allocation in HE, including, their advantages and disadvantages in reference to the above context, to justify the selection of System Dynamic Approach to better interpret the complex dynamic behaviour of education.

Stage Two

Develop a conceptual methodological framework for the research. Identify standard for university's facilities and appealing infrastructure that significant and contributes to the education process quality. A primary research was conducted by directing a questionnaire to evaluate the significance of service facilities in universities in reference to their consumed value in the apportioned financial budget. It was forwarded to the departmental heads of logistics and finance in Egyptian universities (twenty public and twenty-three private universities).

Stage Three

Master the suitable modelling technique that would be appropriate for the research, which is System Dynamics, and in due course the validation and development of a simulating modelling instrument for better funding of resources allocation and budget distribution that maximizes the perceived educational quality based on the conducted conveyed outcome of the questionnaire analysis.

Stage Four

Construct a causal model for the current Egyptian higher education system using CMT (Private University) in AASTMT (Cairo and Alexandria Branches) as case studies and the

faculty of Alexandria (Public University) as the modelling constitution structure. Both represent testing experiments for the higher education context in Egypt.

Stage Five

Produce a set of recommendations for the Egyptian Ministry for better allocation of facilities with limited resources.

1.8 RESEARCH CONTRIBUTION

The suggested model used in this study can used to answer various issues such as:

- Developing better strategies for facilities management in view of its influnce on the quality education system in long-term through the use of System Dynamics modelling in this context;
- Comparing the outcomes of different budget assignments on the perceived quality of education;
- Investigating the influence of change in the budget distribution and its associated allocation of resources in the university educational system;
- Obtaining insights into the facilities service factors that should be most prioritised in importance for the enhancing of the education process quality in universities.

1.9 THESIS LAYOUT

The thesis starts with an introduction (chapter one) to encapsulate the intention of the study and specify its objectives. Then the literature review follows, which is divided into two chapters to identify previous studies that done related to the higher education quality management systems and provide an analysis of all current information relevant to the perceived quality in universities. These chapters (two and three) are designed to identify and comprehend the factors affecting the educational quality and the use of System Dynamics approach in documenting and managing the complex interrelated dynamic behaviour of higher education systems.

The research methodology, in chapter four, proceeds to explain the methods used for data gathering to answer the research question under investigation and give a detailed description of the adopted research strategy and design. The system dynamic model development, in chapter six, structures the body of the thesis that is based on the statistical analysis, in chapter five, of the conducted questionnaire, which prioritised the service facilities in importance

when allocating the resources funding and its associated impact on perceived quality. Then comes the model validation in chapter seven

In the final part of the thesis, chapter eight, all the concluding remarks are tied up and findings are summed up as well to direct for further research in the future. A set of recommendations are presented for policy makers in universities to adopt in order to ensure better educational quality and attain institutional quality improvement goals.

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

Everyday many people join higher education throughout the world hence; quality issues have started to occupy a focal attention. Even more significance has been weighted to the change in the perception of educational quality in universities to effectively manage its facilities and appropriately allocate its resources for the enhancement of perceived quality.

Many studiess have tackled Quality Management in Higher Education in their countries from different aspects, by the elaboration of quality assessment procedures for the sake of controlling the educational standards. Therefore, the different literature written is highlighted in this chapter as an emphasis to the main research aim, which is the impact of the application of facilities‟ quality management on the universities performance. The following sections will review research developments for higher education quality management and related models for measuring quality in higher education and then introduing the theoretical fundmental for the significance of manageing the facilities in higher education.

2.2 HISTORICAL BACKGROUND OF QUALITY

There exists no indication, unanimous upon or globally agreeable definition of the term „Quality‟; nonetheless, there occur quite a range of interference explanations of it. It is not easy to obtain a general globally agreement regarding to quality definitions. It is an issue of the parties involved to negotiation between them (Vroeijenstijn, 1995). Barnett (1994) claims that each university carry specific social and cultural identity and the way it perceives quality affect strongly the adopted quality assurance strategy and policy. Reeves and Bednar (1994) have listed many directions in perception of quality. Harvey and Green (1993) stated the most usable quality definitions as in the following:

- quality as extraordinary;
- quality as completeness;
- quality as suitability for use;
- quality as money value;
- Quality as processing.

Later, Harvey and Knight (1996) clearly identified the related sets of the previous quality dimensions for Higher Education:

- The quality excellencey interpreted clearly in form of high standards;
- The consistency of quality is certainly translated into zero defects;
- The concept of fitness for purpose is unambiguously regarded into matching customer specifications;
- The value for money dimension is normally achieved by means of efficiency and effectiveness;
- And the ongoing process that embraces authorization to react and improvement of consumer satisfaction is definitely used to define the transformative perception of quality.

They further suggested that the dimension of *quality as transformative* combines considerably the other four dimensions.

2.2.1 Quality as Excellence

In this conceptualization, the received quality is considered something unique. The concept of excellence in Quality for private and public universities are underpinned through the institutional vision and mission statements that are framed around the value of excellence (Harvey & Green, 1993). Then Quality is not exceptional, it can be obtainable.

2.2.2 Quality as Perfection

As *perfection*, quality is regarding to the number of defect to reach "zero defect" that is usually used in industrial sector, where the production processes has to fulfil the required specifications of a specific product without any defects. Harvey and Green (1993) further explained that this definition is problematic in educational sector due to two key reasons. Primarily, the results of an educational process are multi-faceted, generally possessing unexpected nevertheless desirable attributes.

2.2.3 Quality as Fitness for Purpose and as Value for Money

Suitability for purpose is commonly the concept of quality in stakeholders point of view of which considered external regarding to university community. For example, labour market focuses on the capability of academies to produce graduates who are satisfying the

fundamental requirements of workplace and best fitting without distorting the enterprises‟ revenues (Lucket, 2005).

This quality concept is matched to governments that are aiming at the alignment of the higher education academies outcomes with the broad national objectives to solve social problems, which is directly connected with the *value for money* concept and its accountability nature to quality assurance.

Bradbery (1991) emphasize that the quality of universities delivery quality should not be fixed; it should be rather dynamic to can follow the work environment changes. Accordingly, universities should comprehensively involve professional bodies for programmes‟ accreditation and employers to stipulate their requirements in the graduates.

2.2.4 Quality as Transformation

Quality regarding to the transformation process defined as the amount of value added in to the learner, which is not tangible and its quantification is challenging. Dill (1995) claimed that stress should be placed towards an improvement-oriented approach that focuses on students, teachers, and internal processes within a higher education institution. Consequently, the use of a balanced approach comprising both process-oriented and the outcome views outfits better. Nevertheless, it is obvious that the educational process enhencment cannot be present without paying attention to stakeholders‟ satisfaction and requirements.

2.3 HIGHER EDUCATION QUALITY DEFINITION

Gordon and Partington (1993) define “quality of education” as the ability of an institution to supply students with dynamic learning objectives that meet the academic standards requirements. Karapetrovic and Willborn (1997) stated that the education‟s quality in universities started to be important issue due to the market requirements become tighter, and to get your degree from university that had a good repetition will not ensure employment in the field of the graduate‟s expertise any more.

The government, employers, families‟ students want to grantee that the will get good quality of education but the question remains in the meaning of what is the “good quality education”.

The enhancement and evaluation of quality has been positioned on top of the higher education agenda. The literature since the late 1980s stated that the focus on the sector of higher education and its factors increasing the interest in quality are usually controversial.

2.3.1 Chronological Categories of Quality realtedto Education Prespective

Owlia and Aspinwall (1996) deduced the higher education quality in different dimensions; quality of service (Parasuraman, Zeithaml &Berry, 1985; 1988), Garvin‟s quality framework‟s (Garvin, 1987), and software quality (Watts, 1987). Furthermore, Owlia and Aspinwall (1996) proposed a framework that complies with West, Noden and Gosling (2000)‟s standpoint of higher education quality. They divide it to three phases Input–Process–Output and named it as (IPO), where the whole requirements are condisered input, the way of teaching and learning are considered process, and the work opportunities and academic standings (Figure 2-1 below) are considered output. This taxonomy of quality features encountered the organisational operational system of inputs‟ conversion represented in raw materials into outputs represented in products/services during the process represented in procedures and policies.

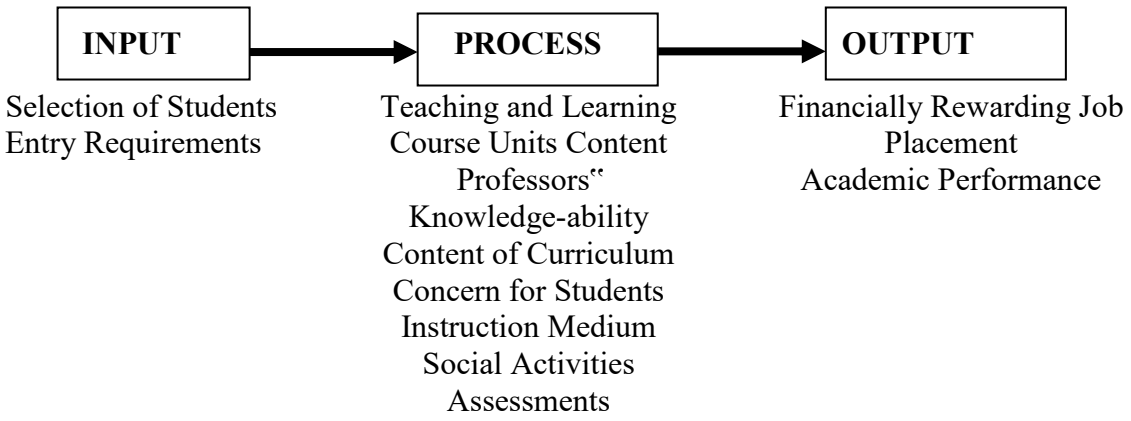


Figure (2-1): the Input–Process–Output Framework of Quality Classification; Source: (West, Noden and Gosling, 2000)

In 2006, Mizikaci presented a systems approach in an attempt to align the expectations of the business sector and the needs of the community with the reform of higher education system. Figure (2-2) gives an illustration of the system view he depicted.

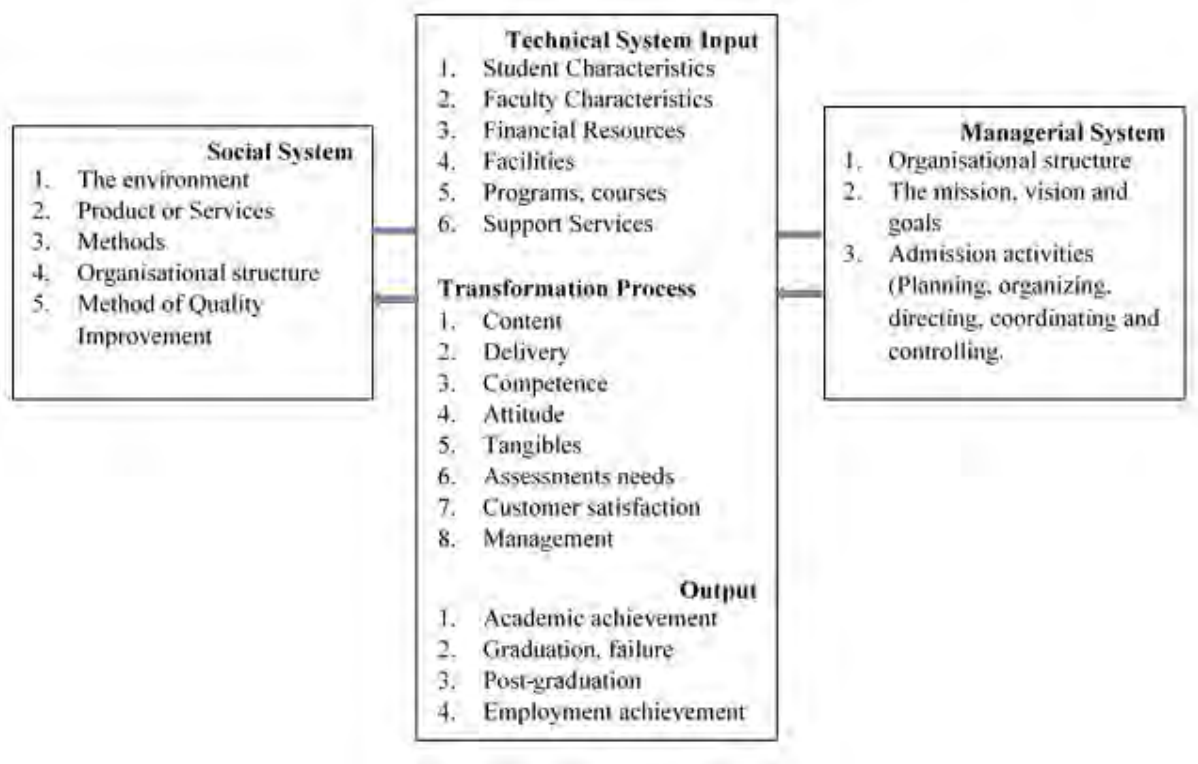


Figure (2-2): A Systems Approach Program Evaluation Model in HE; Source: (Mazikaci, 2006)

2.4 HIGHER EDUCATION QUALITY MANAGEMENT ASSESSMENT

Gueorguiev (2006) indicates that the quality perspective went through different stages as follows:

⇒ **Quality Control** the phase of satisfying customer requirements and performance problem are solved.

⇒ **Quality Assurance** contains all the processes such as design of the product, production processes, product development process, documentation, installation, and service. It embraces the quality regulation of raw materials, manufacturing processes, final products and its elements, services linked to manufacturing and management, manufacturing and inspection processes.

⇒ **Quality Management** comprises managers‟ activities for the implementation of quality policy consisting of quality plans, how to control quality, quality enhancement, and quality assurance.

⇒ **Total Quality Management (TQM)**, which is a management approach targeting the long-term organisational success achievement and sustainability through the reinforcement of employee feedback and participation, the fulfilment of the customer

expectations and requirements, in respect to the values and beliefs of the community, in addition to the regulations of the government.

Srikanthan and Dalrymple (2007) summarized the evolution of higher education system Quality Management through the three phases as illustrated below:

First Before 1990's: Quality Control

The interval before the 1990s embodies the beginning of focal thinking across higher education managerial change. Periodical inspections of academic functions, to be in line with modem manufacturing practice, were deemed adequate to fulfil quality requirements. Consequently, the motivation for quality improvement got steadily lost (Becher et al., 1978).

There exists considerable difference regrading to quality control between educational and industrial approach. As in case of industry, the controllers are considered a part of the foundation for the quality assurance of the fault free functioning products. While the educational academies never launched quality control units despite of the regularity of inspections (Becher et al., 1978). Universities proclaimed their academic freedom through only some formal reporting mechanisms (Shattock, 1996). Accordingly, higher education academies attitude was characterized by a robust aspiration for independence however, in the occurrence of official governmental inspection procedures.

Second After 1990s: Quality Management Philosophy

Since before 1900s, the rules of Quality Management (QM) started to acquisition broad acceptance in manufacturing sector. QM supported a new foundation for empowering workers with morale. In 1980s, the aspect of not only the quality maintainability but also the quality improvement initiated to be delivered as a basic thing in higher education for facing the growing of knowledge complication with minimum increase in costs (Oakland, 1990). Henceforth 1990s, the major concern was directed towards official evaluation of quality in higher education for the alignment with businesses rather than the application of traditional regulations (Brennan and Shah, 2000).

An international study conducted by Brennan and Shah (2000), which aimed to deduce the influences of national and institutional QM in higher education, the Organisation for Economic Co-operation and Development (OECD) program for the programme for

Institutional Management in Higher Education (IMHE) includes fourteen countries. The goals of this project were:

- Through quality assessment different national systems this project focus on illustrate the purposes, methods and the outcomes.
- And to show their influences on decision-making process and institutional management system.

The project entailed two phases: a review system and conceptualization of quality evaluation related to purposes and context; and a series on institutional case studies on the influnce of quality evaluation on institutional managerial decision-making process.

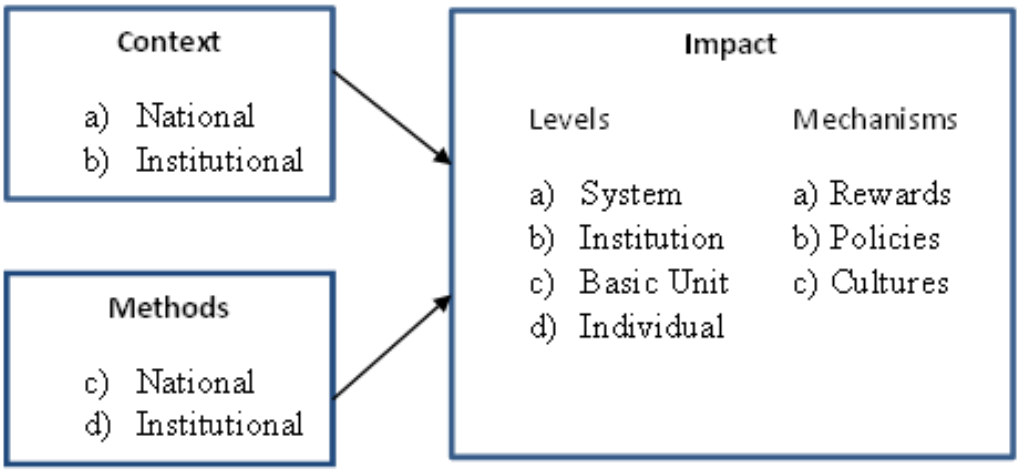


Figure (2-3): The Influences of Quality Evaluation; Source: (Brennan and Shah, 2000)

The researchers have distinguished between levels and mechanisms of impact; and between system, institution, basic unit, and individuals. Figure (2-3) above summarizes the relations, which were explored in the study. The research has been conducted in 14 countries. The researchers have been fortunate in being able to configuer 29 case studies perfromed by higher education institutions. They concluded that there are major differences between institutions and between countries, related to contextual factors and methods of assessments.

Third Stakeholder Perspectives

In any organisation, the management model can grow and lead to successful results if the shared values of the stakeholders are represented (Senge et al., 2000). Table (2-1) below exhibits the quality criteria of the four main stakeholder groups contributing in higher education. For the reason that the providers‟ basic expectations of “value for money” are

exceeded when students are transformed, they satisfy the requirement of "excellence" at the same time, satisfying the "suitability for use" for a competitive service that the employers gain, and leading to the way that the staff can be motivated through regular policies. Therefore, quality as diversion is focal for education development process oriented models to higher education quality system.

Table (2-1): A Holistic Model for Quality in Higher Education Overview; Source: (Srikanthan and Dalrymple, 2003)

Generic Type	Stakeholders Representative Group	Value Expectation	Criteria for Quality
Resources‟ Providers	Funding Bodies	Appropriate return on investments	Value for Money
Products‟ Users	Students (current and prospective)	Competitive advantage in their career	Excellence
Outputs‟ Users	Employers	Competent work	Fitness for Purpose
Educational Sector Employees	Academics & Administrators	Respect as evidenced by remuneration and recognition	Consistency in organisational behavioural norms

2.5 HIGHER EDUCATION QUALITY MANAGEMENT SYSTEM

Institutional quality assurance definition by the academic starandrd as procedures to meet the expectations that have been recognised for students to fulfil for a knowledgeable skilled workforce. Quality assurance defined by the Academic standards as the steps to satisfy the expectations that have been recognised for students to fulfil for a knowledgeable skilled workforce. Furthermore, Van Vught (1996) confirmed that the processes and mechanisms represent the instruments for adequate quality management.

Therefore, this study will trying to create a simulating tool, which provides a comprehensive managerial process for allocation of resources to educational facilities hence, the quality of education offered to students, and thus affects their enrolment and retention.

2.6 TOTAL QUALITY MANAGEMENT (TQM) IN HIGHER EDUCATION

Many universities adopted the TQM path and many authors referred to examples of faculty department or faculty enforcement of TQM. The TQM modelling frameworks will be discussed in details later in section 2.9. Chase and Acquilano (1992) demonstrated that TQM excellence is expressed through customer desired needs. TQM implementation entails an organisation - wide structural system that involves the participation of organisation‟s members in planning and applying continual improvement in all operations aspects. Therefore, total quality management defined as a people-centred approach involving people within the organisation (i.e. employees) who are working at their full capacity to achieve people satisfaction (i.e. customers) outside the organisation (the organisation Consulting Group, 1990).

Taylor and Hill (1992; 1993) summarized the main elements of TQM in the following:

- Continuous self-improvement;
- Costs‟ reduction and processes without any errors;
- Employees‟ commitment;
- Assessment of in-process stored products which done through customer or most probably by the preceding processor;
- Quality conceptualization with respect to customers;
- Segmentation of target customers;
- Timely measurement systems for non-conformance costs.

Jens J. Dahlgaard and Peder Østergaard (2000) defined quality in reference to the fulfilment of customers‟ expectations, total quality achievement at low cost, and involvement of everybody‟s participation for successful total quality management. Furthermore, they described the skills built in education systems in the following three dimensions as shown to Figure below:

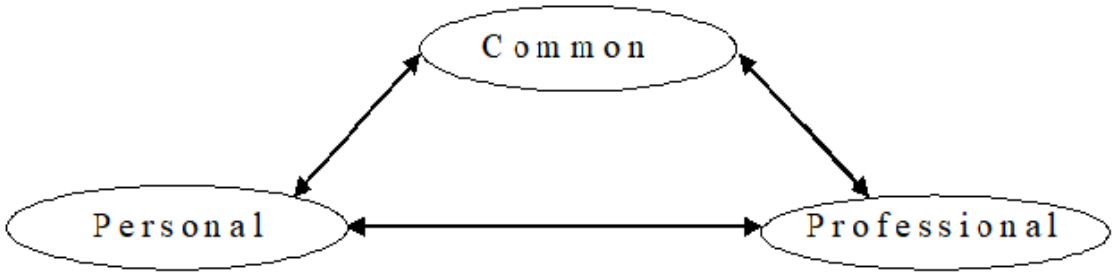


Figure (2-4): Qualifications Built during Educational Process; Source: (JENS J. DAHLGAARD and PEDER ØSTERGAARD, 2000)

- *Common* qualifications represented in these capabilities: reading, writing, searching, sorting and selecting information; speaking, reading and writing in foreign languages; accepting different cultures and understanding environmental issues;
- *Professional* qualifications represented in the broad and highly specialised knowledgeable skills of problem solving techniques and analysis;
- *Personal* qualifications represented in the following abilities: communication skills, projects leadership, critical assessments, teamwork participation, change management, and self-dependence.

The prioritization assigned to these three qualifications varies according to the higher education system, yet professional qualifications in general occupies the first position then comes the personal and the common qualifications respectively. New students who are joining higher education in universities are expected to have their common as well as few personal qualifications already built. Additionally, higher education in reference to the previous priority is in a substantial extent reliant on up-to-date research in the professional capacities under study (Dahlgaard and Østergaard, 2000).

Lin (1993) classifies TQM into two different contexts in higher education: classroom and the administration. In the first context, all employees and academic staff should consider system improvement as part of their job description. Managers must ensure that the working environment is suitable for them to do their best. In the second context, workers and academic staff members should grant that the students finishing their course are satisfying requirements. TQM is concerned with revealing to people the vision, and giving them with the feedback, resources, and tools then, leasing them to perform their jobs (Lin, 1993).

Sahney et al. (2004) adopted the approach that higher education TQM system is the conversion system that embraces the three aspects: inputs, process and outputs for the evaluation and measurement of the operation performance within the university:

[1]. Inputs – embodied in financial, human, and physical resources;
[2]. Process – embodied in teaching, learning, research, administrative activities, which represents the conversion of knowledge;
[3]. And Outputs – embodied in value added tangible and intangible outcomes.

2.7 QUALITY ASSURANCE IN UNIVERSITIES

Due to global competition, universities have been pushed to inspect their delivered service quality, to redefine their product for the fulfilment of customer requirements and to evaluate customer satisfaction using methods that are normally associated with specialists in market serviceing (Kotler, 1985). They must focus on how that the services they offered are good and how quality can distinguish between one university to another (Aly and Akpovi, 2001; Kanji et al., 1999).

Educational services are often problematic to be measured because they are intangible as the result is revealed in the conversion process of students in their behaviour, features, and knowledge (Michael, 1998). Additionally, several issues like autonomy and independence cause difficulties in the overall process of quality assessment (Middlehurst and Gordon, 1995). Accreditation agencies worldwide have been endeavouring to evaluate the quality in universities by the assessment of their degrees given and the scholastic work made. However, higher education institutions precived quality does not affect the operation of these agencies (Parri, 2006). Quality assessment is concerned with certain standards that should be evaluated and compared to the work accomplished so far. Then the deduction of the institutional quality level in question comes afterwards. Besides, the measurement of the quality attributes is troublesome since their associated weights vary in accordance to the different involved stakeholders‟ perspectives (Parri, 2006). The study of Dill (2011), mentioned that he policies‟of quality assurance contribute through forecasting to the social capital development between academic institutions. He used a simple model for the quality process (figure 2-5) introduced by Deming (1986) to investigate the correlation between organisational sources and quality assurance.

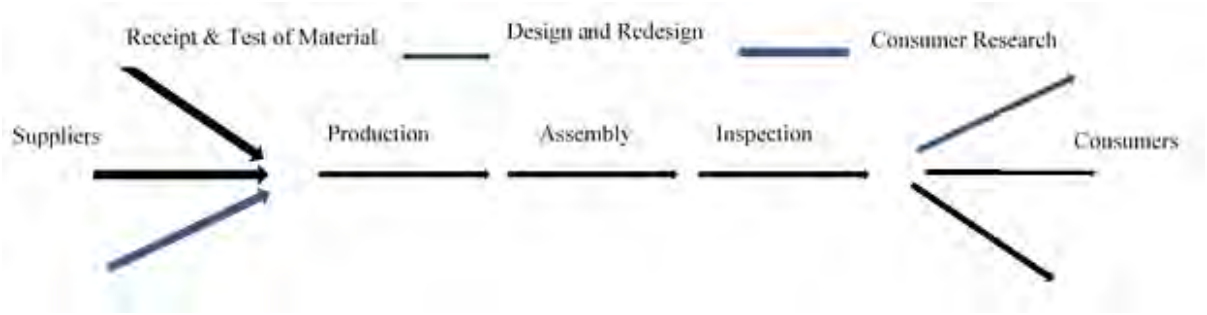


Figure (2-5): Production Viewed as a System, Source: (Deming, 1986)

He observed that the variations in the qualifications of the new entering students influence directly for the quality of education in the academic knowledge and attained skills. He further added that universities will be enforced to change its financial resources and time into evaluation and corrective instructions if variations in new entering students continue to increase.

The study discussed the relation between the quality assurance system and the economic models and, the quality assurance uncomplete information, the quality assurance system and the principal-agent model and the quality assurance, the quality assurance system and the professional self-regulation, and finally the social capital and the quality assurance. He established that quality assurance in academic programmes will necessitate not only promising logical university selections by students, positive remunerations provision for faculty members but will necessitate re-weaving the fabric of the academic communities through the cooperative mechanism for quality control and academic programmes and research. Dill‟s model for quality management will be further discussed in section 2.8.

2.7.1 ASSURING QUALITY IN HIGHER EDUCATION IN DEVELOPED WORLD

The accomplishments of higher educational level in US and European considered the best worldwide (Chen et al, 2009). To develop a comprehensive Performance Measurement Indicators (PMI), measurement of university performance indicators examples are represented below in alphabetical order:

- Australia Higher Education Indicators (Australia Higher Education Institutions, 2000);
- Committee of Vice-Chancellors and Principals of the United Kingdom/University Grant Committee (CVCP/UGC) higher education indicators (CVCP/UGC, 1987);

- Higher Education Indicators system founded by Wang (1993) and Chian and Lee (2001);
- Malcolm Baldrige National Quality Award (MBNAQ, 2004);
- Taiwan Ministry of Education (MOE) Qualitative and Quantitative Indicators (MOE Highest Commander, 2003);
- UK University Committee Reports (Chen, 1997);
- UK University Education Evaluation Newspapers including The Financial Times, The Guardian, and The Times (Chen, 1997);
- US News & World Report (Morse and Flanigan, 2002);
- US University Education Evaluation Articles including Gourman Report, Princeton Review‟s Best 311 Colleges (American International Education Foundation, 2004).

Vickie Schray (2006) showed that US accreditation process has developed over the past years due the changing environment of the higher education, which can be summarised into the following three changes:

1) the increased demand for accountability;
2) the decreased fund and continuing burdens for more cost-effective solutions; and
3) The instable variable of higher education and transsmison counting new types of educational academies and institutions and the extensive use of online learning permitting the operation of institutions across borders nationally and globally.

United States‟ accreditation system has been used over hundred years as the principal roadmap for quality assurance in the delivery of higher education services. These accrediting bodies set the quality standards for the determination of whether the applying institutions with its available provided programs fulfil these standards or not. Accordingly, whether or not they are qualified enough to obtain funds on annual basis (Schray, 2006).

For instance, the U.S. Department of Education has settled standards for addressing the recognition of accrediting organisations that are established based upon the federal legislation. These standards effectively are indicated in the following (Schray, 2006):

a) Compliance record with the institutional programs‟ responsibilities depending on up to date program reviews, financial audits, and any other information that may be provided to the agency;
b) Curricula;
c) Equipment, facilities, and supplies;

d) Faculty;
e) Financial and administrative capacity in reference to operations‟ scale;
f) Length of offered program length and the objectives of the obtained degrees measurements;
g) admissions‟ practices and recruitments process, grading systems, academic calendars, catalogues, commercials, and publications;
h) Student support services;
i) Students‟ complaints record; and
j) Success in reference to students‟ achievement in alignment with the institutional mission, course completion, licensing examination, and job placement rates.

Additionally, in 1998 the Council for Higher Education Accreditation (CHEA) promoted five key standards for the formal recognition process (Schray, 2006):

1. Advances in academic quality;
2. Continual reassessment of accreditation practices;
3. Demonstration of accountability;
4. Encouragement of required improvement; and
5. Use of the suitable procedures to support the decision-making process.

2.7.2 Performance Measurement Indicators (BSC)

The Balanced Scorecard (BSC) indicates the ability of businesses to change its organisational plan into operative management. Kaplan and Norton **(**1992) and Niven (2002) regarded the BSC as a communication device. Kaplan and Norton (2001a) viewed the balanced scorecard system as system for performance-measurement, and in Kaplan and Norton (1996a, 2001c), they perceived it as a strategic-management system. They also suggested that it gives emphasis to the consumer role, internal processes, learning and heterodoxy through the provision of a complete group of indices for the measurement of the achievement of strategic goals in perspective of customer, financial resources, internal process, growth and learning (Kaplan and Norton, 1996b, 2001a).

BSC has been broadly applied in service and manufacturing industries, non-profitable and governmental organisations, etc. with outstanding results (Kaplan and Norton, 2001b). Kaplan and Norton (2001a, 2001b) further added that the stakeholders or customers perspective comes on top of the list even though financial performance is one of the most essential measurement indicators.

2.8 HIGHER EDUCATION'S QUALITY MANAGEMENT MECHANISMS

Since the late 1980s ahead, in the industrial sector a growing interest has been taken place regarding to models of quality such as Total Quality Management (TQM) in the higher educational but the non-existence of an agreed upon total quality management model weakens efforts in this direction. Birnbaum (2000) studied different models of higher education management that eventually become abandoned. One year earlier, Birnbaum and Deshotels (1999) make a survey in the United States, which include about 469 higher education academies that established, and implemented TQM approached in higher education. Similarly, Grant et al. (2004) asserted that the official models of quality management system are not convenient for academia.

Further, Vazzana et al. (2000) asserted that TQM is not only concerned with fundamental learning and teaching processes. TQM‟s surveys showed widespread dissatisfaction, for example, Myers and Ashkenas (1993) discovered that two-thirds of the surveyed institutions asserted that their TQM programmes were not effective. Seymour (1991) reported that the TQM execution in higher education academies perceives frustration and needs a high investment of time due to the following:

- The absence of administrative commitment;
- lack of personnel training;
- organisational concern of inadequate tangible results;
- resistance to change;
- shortage of members‟ concept of teamwork; and
- the shallow adoption and implementation of TQM tools and deficiency of its operation as a working philosophy.

Furthermore, the quality management standard ISO 9001:2000 the good system that could represents the quality management system nevertheless its production process function is too broad. Nevertheless, the excellence models such as the EFQM and the Baldrige do not enclose a real system and are applicable only for outstanding institutions. There have been many new models and re-assessment of previous models of the basic educational processes, which presented for the delivered quality in higher education. Harvey and Knight (1996) developed a Transformative Model representing the best suitable learning-oriented approach to quality. They affirmed that the prominence should be assigned to the empowerment and

enhancement of participants and the value-add to their capabilities (Harvey and Knight, 1996). Haworth and Conrad (1997) elaborated an Engagement Model of quality programme that is structured about the focal idea of engaging the student and the faculty in the teaching process. Furthermore, Tierney (1998; 1999) aggregated the viewpoints of several leading authors into one model for excellence to end up with a responsive university and highlighted the communication and partnerships develop new internal and external relationships.

As illustrated above, many of authors have contributed to improve different aspects of quality management in higher education apart from quality modelling but from an educational perspective. Dart & Boulton-Lewis (eds, 1998); Mitchell (ed., 1998); Stephenson and Yorke (1998); and Leigh-Smith and McCann (eds, 2001) were concerned of how to enrich the delivery of teaching and learning. While Brennan et al. (eds, 1999); Lucas et al. (2000); Van Patten (2000); and Ruben (2004) focused on the adoption of conducive management methodologies. The following will illustrate various reviews of vital educational processes and numerous models that have been presented for quality management in higher education institutions.

Massy' s Six Quality Process Categories Model

Massy (1997; 2003) examined the institutional, departmental and faculty quality system educational processes that contain these six Categories: desired learning outcomes determination, the design of faculty‟s curriculums, design of teaching and learning methods, design of students examination methods and the use of examination results, quality implementation, and resources commitment for the quality of the educational environment. Each domain will be briefed below.

- *Desired learning outcomes determination* focuses on the objectives of study programmes and their links to students‟ requirements embracing their capabilities, prior knowledge, employment opportunities for being effective in the society and value-add to the quality of life.
- *Design of faculty's curriculums* addresses required operations to portray and enhance programme curriculum including: the teaching content and the perspective viewpoint adopted; the inputs‟ role from students, employers, staff and others (government, society); effort made to obtain a consistent curriculum that is aligned with the programme goals offered while assuring the standard of academic programmes; and resolving the controversies.

- *Design of learning and teaching technique* that consists of the design processes, review and enhance teaching materials of and learning environment to include: deliberation of desired and learning process outcomes; inputs from outside the faculty and students‟ viewpoints; forums and mobility exchange opportunities for staff members; and reinforcement of innovation.
- *Students examination methods and the use of examination results* deals with the processes to design, review and enhance the examination of student learning and its alignment to educational goals, to embrace the responsibility‟s distribution for examination; feedback system for the improvement of examination; and the enhancement processes of the examination relationship to educational objectives.
- *Quality implementation* is concerned with the assurance of the coherence of curricula, teaching, learning outcomes, learning and tests design and operations in accordance to the plan. That includes teaching standards promotion system and operations to grantee and improve the quality of teaching perceived; staff recruitment and development; and learning and students‟ assessment, with respect to the student-teacher interaction; student feedback forms; peer reviews; measures the learning experience of the student that they gain from outside the classroom; and techniques to react to the previous indicators.
- *Resources commitment* refers to the organisations‟ allocation of resources for quality of education environment improvements through quality management operations sufficient funding, and the recognised rewards system for performance accomplishment in conveying educational quality.

Higher Education's Quality Management Generic Model

Srikanthan and Dalrymple (2002) introduced a generic model for quality management system to addresses the process of education combining the learning, transformative, the responsive university, and engagement model of quality programme all together. The characteristics of their generic model apprehended the following:

- The empowerment of learners through the value-add to their capabilities. Therefore, quality policies should be oriented towards learning and focused on the student experience;
- The importance role for leaders in higher education institutions for inspiring an appropriate collegial culture; and

- The necessity of the collaboration between the traditional student-teacher relationships and also across organisations in order to develop innovative outside participations within the community, which indicates being community centred in outreach, student centred in programmes, and nation centred in research.

The Three Dimensions Quality Model

Mergen et al. in (2000) introduced the three dimensions quality model, which deliberated a set of measuring parameters to assess the educational quality and its associated tools. The framework of the introduced quality management model consists of three dimensions as described in the proceeding section: Quality of Design (QD), Quality of Conformance (QC) and Quality of Performance (QP). Figure (2-6) outlines the model suggesting that there is a rational stream flow from quality of design to quality of conformance and quality of performance. For instance, if the quality of performance was low it cause deviation in the quality of design and/or quality of conformance. Alike, if quality of conformance was low it can entail preferable controlling quality methods or alterations in the phase of design.

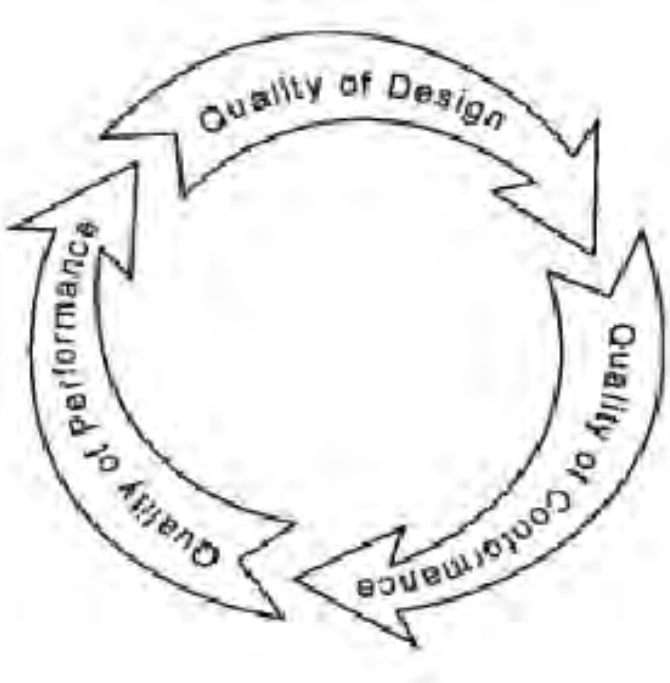


Figure (2-6): Three dimensions quality model; Source: (Mergen et al., 2000)

- *Quality of Design* that determines the features of a good educational system in a predefined market segmentation at a predefined cost through three components:

[1]. Stakeholders‟ quality comprehensions and their needs;

[2]. The quality of the educational operation to transform these needs into a product/service for value-add provision; and

[3]. The constant development of the design opeartion.

- *Quality of Conformance* highlights the extent of how appropriate the designed requirements are fulfilled through the variance minimization from requirements design phase of the products/services, including the budget requirements, similarity and dependability. Accordingly, proper measures should be established to ensure that requirements for design phase are being satisfied.

- *Quality of Performance* aims at determining range of fitting of the educational system in serving the students in their surrounding areas. It acts as a value-add measurement that students attain from their education taking into account the career advancement, employers‟ salaries, endowment level, stakeholders‟ satisfaction, student enrolment and tuition revenues.

After two years, the researchers used the same previous model proposed in year 2000 to present a set of recommended measures and tools for research and curriculum development. The following table exhibits those measures (See Table 2-2).

Table (2-2): Curriculum Development Measurements Parameters and Tools; Source: (Widrick, Mergen & Grant 2002)

Framework	Measurements Parameters	Measurements Tools
Quality of Design	- Market needs	- Survey, interviews
	- Skill requirements manufacturing knowledge	- QFD, focus group
	- The required training for educational process	- Focus group, benchmarking surveys
	- The required skills and knowledge	- Focus group, benchmarking surveys
	- Module content	- Affinity diagram
Quality of Conformance	- Program design	- Reviews of industry partners
	- Course sequence	- Confirmation check sheet
	- Course content	- Student feedback
Quality of Performance	- Program design	- Review, analysis, feedback
	- Course content	- Evaluation industry feedback

They evaluated the educational requirements for managers to be capable of determining the college‟s needs and identified the need of the market to develop a specific product idea. The market needs included three requirements: skills and knowledge requirements in order to succeed in the manufacturing, the required educational training program for manufacturing, and the skills and knowledge requirements of the region.

The researchers concluded that the quality tools only served as dean‟s advisor in the phase of design. Yet, the stages of performance and conformance are still needed to be achieved. They also confirmed that the college environment has improved even though it exists in the early phase.

Academic Quality Management Dill's Model

Dill‟s model (1992) advocates that the programmes for higher education could be perceived as an correlated connected system through which numerous sources give supply to educated students via a designed featured programme precise educational processes that are then positioned at different consumers. Programme for educational must be in continuous design and redesign depending on the requirements of the stakeholders along with organisational expertise and knowledge. Further, he added that the academic quality management is composed of the selection of students and management of resources; design of academic programme; research on customers‟ requirements; in addition to the support of quality information system as illustrated below.

- *Management of resources* requires the identification and pursuing of higher education academies in reference of their student quality over a period. The concept of quality management system from the academic perspective, great assertiveness take place on the link between the students‟ selections and their long-term success, as well as the integration of the process design of the academic programme and the selection of selection.
- *Academic programme design* pinpoints the improvement of the require skills of teachers in the course plan and the assessment of students stressing the significance of cross-functional design teams, materials production and educational assessment. The primary recognition of the academic programme essential components that can lead to the good student learning and the reduction of predictable variation in academic quality.
- *Research on customers' requirements* is conducted through organisational alumni, in addition to potential employers in relevance to their academic knowledge and skills of post-academic success.
- *Quality Information System* enfolds the performance measures of the applicants, accepted students, current students enrolled at programmes, programme graduates, other than the measures of alumni expectations and drop-out rates. The gathered

information can be then forwarded and contributed to the design of the active programme.

Holistic Educational Development Model

D"Andrea (2000) established the *educational development* model, which is concerned on the management of three core areas: academic development, quality development, and learning development. Figure (2-7) elaborates the linkages between these areas. The model concentrate on the model of educational development activities by creating a „quality circle" that affirms the development, educational provision implementation and evaluation as a full circle the operation of development of the curriculum in alignment with existing pedagogical knowledge theory and practice.

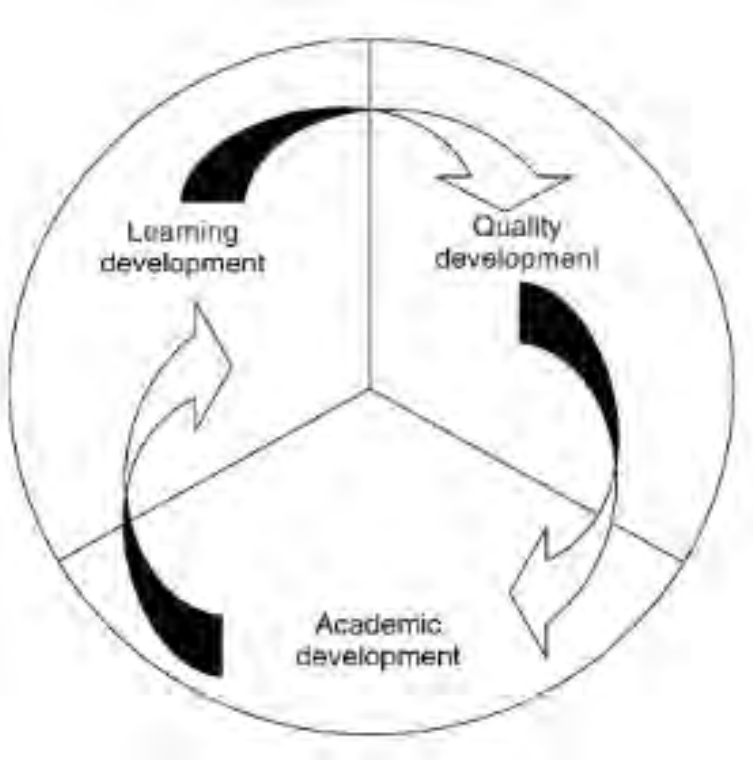


Figure (2-7): Holistic Educational Development; Source: (D'Andrea, 2000)

Veress' s Quality Management Model

Veress (1999) viewed from an engineering perception the of higher education quality management. He demonstrated quality as the stakeholders" satisfaction and affirmed that the process of meeting demand has quality in accordance of the interpretation of modern quality management, while manufacturing and/or customer processes do not have. Moreover, institutions can measure or estimate its education quality through meeting stakeholders needs

on the other hand they cannot replicate the processes under the same conditions if they do not possess well-defined regulations, educational and conformity control processes. Consequently, they would not be able to know what to change for enhancement.

2.9 GENERAL QUALITY MANAGEMENT FRAMEWORKS

The following will discuss the most popular modelling frameworks such as Total Quality Management, Excellence Framework Quality Model and ISO Standards.

Total Quality Management (TQM)

Certain Total Quality Management TQM rules connotations influnces implementation of TQM and are vital for organisational success (Kanji & Tambi, 1999). Figure (2-8) below introduces the higher education academics TQM model that integrates numerous essential success factors. Kanji‟s (1998) model contends to be widely useable, in dissimilarity to some other TQM techniques, because it clearly shows its principles and assumptions facilitating the attaining of the success factors for its development in higher education academics. Moreover, leaders in organisations have to take the TQM rules and basic concepts as guidance for the achievement of business excellence (Kanji et al., 1999).

The implementation of TQM model was introduced in three countries USA, the UK and Malaysia by 183 higher education institutions in: the (Kanji, 2001). Kanji‟s (1998) model is built on four rules: customers‟ satisfaction; continuous improvement; fact management; and people-based management. In this model, leadership represents a leading key and must be transferred through all the rules and core concepts for the achievement of business excellence. Core concepts serve as those managerial areas that should be given distinctive and continuous attention to guarantee high performance. These factors are acutely critical for the reason that if they are not implemented properly, the organisation will not be able to achieve the excellence of business. They are also absolutely useful by managers and leaders for missions, policies and decision making (Kanji et al., 1999).

The idea of the Quality Management approach is summarized in that each item gets external environment inputs and converts those inputs into outputs for an external market, where this conversion is called a as a process. The ISO 9000 family adopted and promoted the “process approach” as defined in the proceeding section.

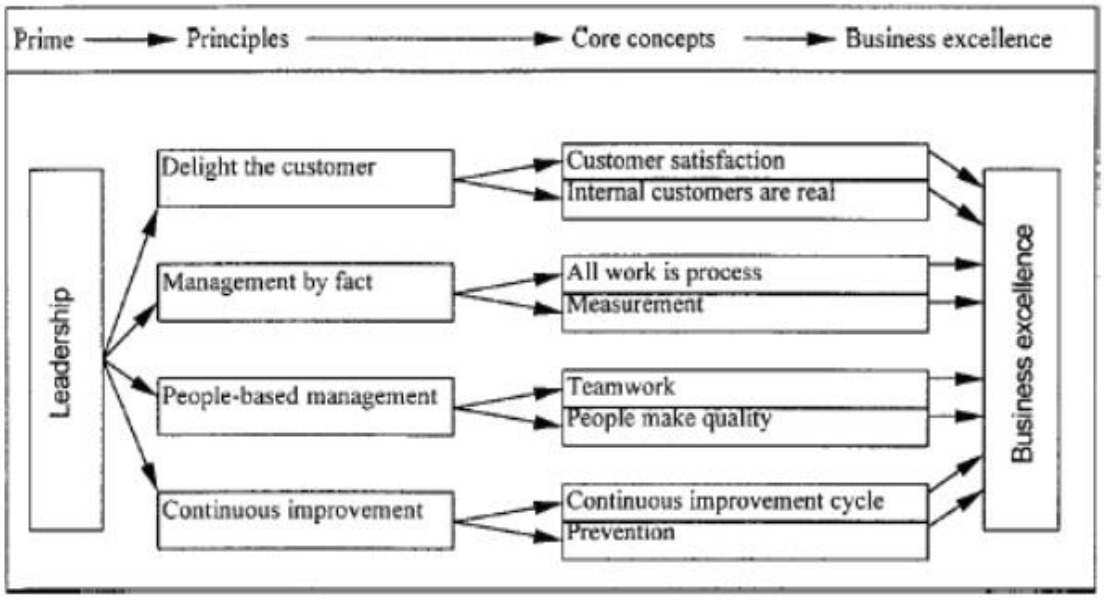


Figure (2-8): Business Excellence Model; Source: (Kanji, 1998)

ISO 9000 Standards

ISO 9000:2000 represent a series of standards established to support companies in the successful enforcement and processing of quality management systems. ISO 9000:2000 is a procedural program that exemplifies a tangible concrete step towards quality management, as it seeks the product quality assurance as well as the customer satisfaction assurance (Conti, 1999). ISO standards encompass three divisions: ISO 9000:2000, which comprises the fundamental concepts; ISO 9001:2000, which includes the quality management system specifications; and ISO 9004:2000, which acts as a guide for those companies in particular that, aims at additional enhancement for their quality system.

ISO 9001 standards are different from 9004 standards. The 9001 is termed as the „good enough" model that describes the minimum requirements for quality management systems. Organisations can be awarded their certificate if they fulfil the requirements. While the 9004 model assists in developing a management system that is beyond the status of minimum requirements. ISO 9001 and ISO 9004 are similar in terminology and structure. Figure (2-9) conceptualizes the ISO 9001 model. ISO 9004 not only comprehends the requirements of ISO 9001 but also attaches recommendations to give impressive enhancements. In other words, ISO 9001 acts a strong firm basis for governmental regulations and contracts among partners and. Its certification attracts the companies themselves, the suppliers they deals with, their consumers, for state authorities, legislative organs and the community at large. ISO 9004 is a

continual journey for the enhencment of the quality management system commencing with the least stage of ISO 9001 (Seghezzi, 2001).

Figure (2-9): The Basic ISO 9001:2000 Model; Source: ((Seghezzi, 2001)

Moreover, Kanji and Tambi (1999) and Kanji (1998) declared that ISO 9001 and TQM could be combined together for total quality system development. Further, they suggested the utilisation of the EFQM model for the process by means of an integrated self-assessment framework approach. The EFQM model would be mentioned next because of its importance. The AASTMT is considered one the educational Institution that first receive quality certificate regarding to education filed (ISO 9001) for the Bachelor degree in Maritime Transport Technology, Engineering and Management. The certificate aken in 1999 from one of DNV Ceritification Company that considered one of the leading company regarding to ISO certifications.

EFQM Model

The EFQM model constitutes a set of systematically enunciated criteria to represent the various company‟s areas. The EFQM rules distinguish the prominence of consumer satisfaction and the significant leadership function. It expresses a holistic view of quality/excellence through its broad illustration of cooperation, its solid highlighting on operations and on continuous enhancement, its concentrate on learning, innovation, and people significance and mutual advantageous of the relationships between suppliers, also the enclosure of general responsibility and its comprehensive system to outputs. It includes nine

criteria, representing a group of „enablers" (leadership, people, partnerships and resources and operations, policy & strategy,) and a group of „results" (customer results, people results, influence on society and business results) as demonstrated in Figure (2-10). Any organisation can practise the EFQM model for progression evaluation towards excellence as enablers can define what organisations should do.

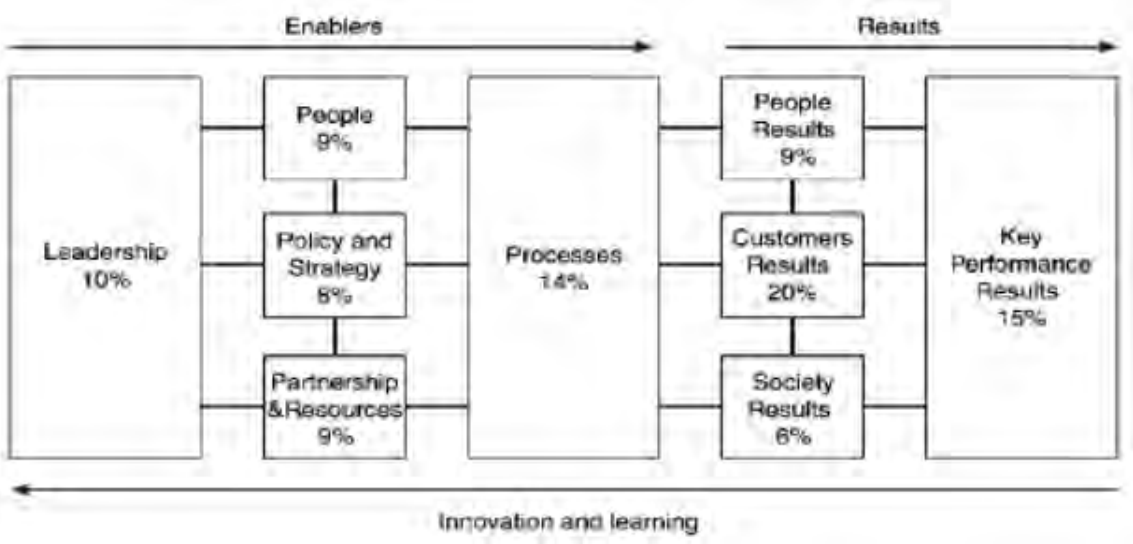


Figure (2-10): EFQM Model; Source: (European Foundation for Quality Management, 2003)

Calvo-Mora, Leal and Roldan (2006) tried to investigate the implied correlations among the enablers of the European model in order to function as a fundmental for the quality management and improvement in higher education institutions. Their implementation was reliant on the European model of the European Foundation Quality Management (EFQM) as shown in figure (2-11) below.

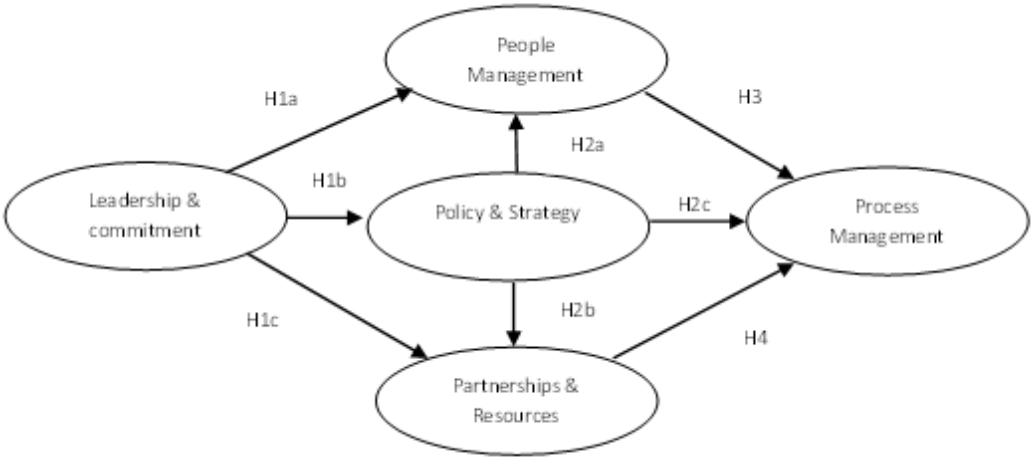


Figure (2-11): Research Model and Hypotheses; Source: (Calvo-Mora, Leal & Roldan, 2006)

From the above figure, the following hypotheses were extracted:

With respect to leadership:

H1a. The management leadership has a positive constructive impact on people management.

H1b. The management leadership has a positive constructive impact on policy and strategy.

H1c. The management leadership has a positive constructive impact on resources and partnerships.

With respect to policy and strategy:

H2a. Policy and strategy have a positive constructive impact on people management.

H2b. Policy and strategy have a positive constructive impact on partnerships and resources.

H2c. Policy and strategy have a positive constructive impact on process management.

With respect to people management:

H3. People management has a positive constructive impact on process management.

With respect to partnerships and resources:

H4. Partnerships and resources have a positive constructive impact on process management.

By the analysis of the relationships‟ structure in the proposed model, operation management seems to be the linkage between the results and the other agents.

The researchers used a self-assessment philosophy followed by questionnaires to collect data. The questionnaires were directed to the senior staff at the university in the operational centre like facilities, and universities schools. Three hundred forty six (346) centres of the public spanish universities formed the population studied. The results obtained in testing the hypotheses confirmed that:

- Firstl thing, senior‟s officers‟ leadership and commitment of the centres represent the driving-force of the entire quality management and enhancement processes.
- Second thing, the policy and strategy must serve as a reference for staff policy setting and the management of processes and resources.

- Third thing, proper people management is the fundamental of the processes management.

Researchers confirmed that the outputs gained from the structural model analysis supports the European model validity as a reference structure for the implementation of quality program in higher education.

2.10 OVERVIEW OF APPLIED QUALITY MANAGEMENT MODELS IN HE

Becket and Brookes (2008) reviewed published papers in educational journals for the decade from 1996 to 2006 in a trial to scan all applied quality management models even the industrial one. So that they can further investigate current practices‟ implications in general and within leisure, hospitality, tourism and sport management programmes in specific and accordingly develop their quality management system model for higher education and the implications of current practice.

They justified the challenging task of managing quality in HE for two key reasons. Firstly, the meaning of „quality‟ differs for different stakeholders especially in HE because of the presence internal and external stakeholders who are expected to have distinctive or even sometimes opposing inconsistent quality definitions. As previously advocated by Cheng and Tam (1997) that “educational quality is a controversial and vague concept correspondingly”, Pounder (1999) claimed, “Quality is an ambiguous notoriously term and hence the challenge in quality‟s definition, its measurement and management ascertained an obvious debate”.

Secondly, the educational product has a complicated nature. Deming (1993) viewed education as a system entailing inputs, transformation operations and outputs or interdependent components of a network working together to achieve the system aim. Martens and Prosser (1998) further appended that high quality learning should concentrate on deep learning approaches, instead of reproduction. Yet, Yorke (1999) advised that if the quality of teaching was high that does not continuously lead to high quality learning or vice versa.

The examination results, earnings, employment and satisfaction could reflect the outputs of the educational system. However, Harvey (1995) contended that there occurs no obvious fial product of higher education because the transformative operations remains in order to create an influence after accomplishment of the higher education. Additionally, Owlia and

Aspinwall (1996) claimed that different stakeholders are the ones who should evaluate the significance of the quality dimensions in reference to their individual interest and motivations. For instance, quality a*s* money-value is probable to be estimated separately even by several internal stakeholders. Students possibly will evaluate money-value in relation to lectures fees paid against interaction-supplied time, while manager of every department is expected to be more interested in the effective utilisation of resources in comparison of the number of students.

As a result, Brookes and Becket (2007) made a review to examine recent environmental changes and their influence on higher education and quality management implementations in nationally dissimilar circumstances. The next tables outline the some models for quality management system with their description in Higher Education Institutions.

Table (2-3): Quality Management Models; Source: (Brookes & Becket, 2007)

Model	Definition
TQM	An inclusive management tactic that calls for the contribution of organisational participants to aim at long-term benefits for those who are concerned and the whole society as well.
EFQM model	Non-prescriptive structure that launches nine standard which is apportioned into enablers and results and can be applied for any organisation in order to evaluate progression towards business excellence.
Balanced scorecard	Performance/strategic management system that exploits four measurement approaches including the financial funding; the consumer; the internal process; and the learning and growth perspective.
Malcolm Baldridge award	Depends on a structure of performance excellence that organisations can use for the reason performance improvement by means of seven criteria categories: consumer and market concentration; human resource focus; knowledge management; operation management; leadership; measurement analysis; strategic planning; and results.
ISO 9000 series	International standard for public systems for quality assurance that is adapted to the continual enhancement of customer satisfaction and regulatory requirements.
Business process re-engineering	System that empowers the redesign of business structures, operations and systems to accomplish better-enhanced performance. It involves change in five components: culture; organisation; operations; strategy; and technology.
SERVQUAL	Instrument that is developed for the measurement of the consumer expectations and perceptions about service quality in five dimensions: assurance and empathy; gap identification; reliability; responsiveness; and tangibles.

Table (2-4.a): Quality Management Models Applied in HEIs; Source: (Brookes & Becket, 2007)

Model Adopted	Author, Year	Findings
Modified (SERVQUAL)	Ford et al., 1999; Kwan and Ng, 1999; Abdullah, 2006; Markovic,2006	• Competitive advantage in higher education entails evaluation of the views of the customer and responsiveness to the processes management. • Perceived quality influences customer satisfaction. • Attributes might not be transferred across cultures. • Performance Indicators (PIs) designate the measurement of activity, not the quality of education hence, the student experience should be addressed.
EFQM	McAdam and Welsh, 2000; Osseo-Asare Jr and Longbottom, 2002; Hides et al., 2004; Calvo-Mora et al., 2006; Tari, 2006	• Reflects an incorporated roadmap of management areas that are valuable to gain the confidence of several stakeholders. • Represents a basis for self-assessment. • Assesses the connection between enablers and results. • Implementation involves assurance to medium and long-term programmes, attention to customer delivery and top-level commitment. • Allocation of resources should be managed through policy. • Benefits may be witnessed after three to five years. • Managerial skills in HE are challenging. • Greater benefits are attained in case of the integration between the EFQM and national HE control mechanisms.
Balanced scorecard	Cullen et al., 2003, Chen et al., 2006	• Performance management and evaluation should maintain the utmost attention. • Performance Indicators should be aligned with strategy and management; or else they could be dysfunctional. • Scorecard could be exercised for performance management rather than merely monitoring.
Malcolm Baldridge award	Arif and Smiley, 2004	• Returns in operational elements such as: budget and strategic planning; careers; information services; and outreach. • Immediate and long-standing benefits can be rewarded.
ISO 9000	Shutler and Crawford, 1998	• Describes the higher education product as students' learning (British Standards Institute (BSI)). • Continuous enhencment can be achieved via preventative action. • Less technical control is required in educational products in contrast to manufacturing.

Table (2-4.b): Quality Management Models Applied in HEIs; Source: (Brookes & Becket, 2007) Continue

Business process re-engineering	Welsh and Dey, 2002; Sohail et al., 2006	• An assessment strategy is suggested for both internal and external stakeholders. • Quality assurance is supported by the use of technology. • Some responsibilities for assessment are assigned to the course level. • Restructuring in core processes empowers HEI to become improvement-driven. • Efficiency, productivity, and service levels identify enhancements. • Cost-effective method is utilised for improvement and accountability purposes.
TQM-related	Five-Step Programming Model (Motwani and Kumar, 1997); Continuous Quality Improvement (Roffe, 1998); Self-rating Scales (Pounder, 1999); Service Guarantees (Lawrence and McCollough, 2001); TQM (Aly and Akpovi, 2001); Quality Management Framework (Widrick et al., 2002); TQM in Higher Education (Srikanthan and Dalrymple, 2002); Hoshin Kanri Model (Roberts and Tennant, 2003); QFD (Thakkar et al., 2006; Hwarng and Teo, 2001)	• Inspired discipline of thinking about tangible and intangible aspects of operational aspects and academic activities are needed in the design and delivery of courses. • Enhancements were acknowledged in customer service, course quality, personnel hiring, staff and faculty morale, and university processes. • The participation of students, faculty and funding bodies is recommended. • Considerable TQM in HEIs in the USA has been implemented in finance/administration services. The broadening to teaching is the real contest. • TQM is suitable for service aspects, whereas teaching and research need different approach. • Campus-wide strategic planning, lack of resources, leadership, and resistance to change formulate the challenge. • Determination of the role of the students is troublesome as they can be viewed as customers, consumers, or co-producers. • Other limitations is linked to: the complexity of outputs' definition; associated challenges to leadership skills; the inconsistency of the TQM requirement for teamwork/customer participation in reference to the acceptance level of TQM concepts & principles; autonomy of academic staff; bureaucratic structures; difficulty of its implementation to higher education; and people rather than process orientation.

Table (2-5.a): Quality Management Models Developed for Higher Education; Source: (Brookes & Becket, 2007)

Model Adopted	Author, Year, Origin	Findings
Model for quality management in higher education	Srikanthan and Dalrymple (2002, 2003, 2004), Australia	• Adopted approach mainly relies on evidence descending from educational literature. • Four methodologies are required: engagement theory of programme quality; methods for the development of a learning university; transformative; strategies for attaining a responsive university. • Regarding the teaching and research, students act as participants and their learning is the fundamental focus. • Implementation of 2002 model was concerned with approaches and philosophies to student learning and methods of producing a dynamic collaboration around student learning. • Change in focus is suggested from the procedural of teaching to academic productivity, organisation performance and student learning. • Radical transformation is acquired; handling the student learning as the focal criterion.
Excellence model	Pires da Rosa et al. (2001, 2003), Portugal	• Self-analysis should be supported and regarded as a source for the quality improvement, and accordingly result in strategic development. • Evaluation activities in teaching and research are positively related to quality management.
Academic award model	Badri and Abdulla (2004), UAE	• Research, services and teaching should be assigned the most interest in order for the development of a clear approach to faculty rewards/awards. • Model enclosed criteria for contributions to conferences and workshops, course development, course files, diversification, material production, student evaluation, and teaching portfolio.
Model for the quality assessment of learning outcomes and student experience	Tam (2002, 2006), Hong Kong	• Student growth enrolment should be used to assess quality in higher education in terms of cognitive and non-cognitive aspects of learning, skills and satisfaction with university environment. • The relationship between student outcomes and university experience could represent an approach of defining a university's success in fulfilling its educational goals.

Table (2-5.b): Quality Management Models Developed for Higher Education; Source: (Brookes & Becket, 2007) Continue

Multi-models of quality in education	Cheng and Tam (1997), Hong Kong	• Seven models of quality in education were acknowledged to reveal the complexity of pursuing educational quality. • Performance could be represented in terms of quality and effectiveness, and these terms are comprehensive and become tangible on longer-term goals. • There exist some cross-cultural issues that call for further investigation.
Performance measures for academic departments	Al-Turki and Duffuaa (2003), Saudi Arabia	• A system approach was adopted to examine performance measures for the evaluation of efficiency, effectiveness, departmental internal structure, productivity, growth and development. • Hierarchical performance measurement model is assessed through outcome measures for input, process and outputs.
Internal audit	Reid and Ashelby (2002), UK	• Internal audits that identify for example substantial cultural changes can strengthen quality improvement; produce better staff involvement, in addition to retaining benefits to the institutions. • Deliberates collaborative provision and value added, external examining processes, programme development, management, and evaluation, staff development, and students' assessment.
Internal audit	Becket and Brookes, (2006), UK	• A model was proposed to review quality management approaches in departments in terms of six dimensions: enhancement or assurance focus, internal/external perspective; qualitative/quantitative information; quality dimension assessment; snapshot/longitudinal timespan; and system elements.
Quality dimensions framework	Owlia and Aspinwall (1996), UK	• Thirty different quality characteristics were demonstrated for higher education, using generic dimensions for quality definition derived from manufacturing/software and service methods.
Programme evaluation model	Mizikaci (2006), Romania	• Interprets higher education as a system consisting of input, processes and outputs for programme evaluation through which management, social, and technical systems are identified.
Quality management framework	Grant et al. (2002, 2004), Widrick et al. (2002), USA	• Quality of design, conformance and performance express the quality dimensions in higher education.

Table (2-5.c): Quality Management Models Developed for Higher Education; Source: (Brookes & Becket, 2007) Continue

Subject quality assurance system	Martens and Prosser (1998), Australia	• The system of quality assurance in universities empowers systematic review and permits for discipline-specific requirements. • The enhancement of student learning formulates the main concern.
ISO-based TQM model	Borahan and Ziarati (2002), Turkey	• Merge TQM, Malcolm Baldridge and ISO 9000 principles, applied on USA and UK practices to distinguish quality criteria. • Demonstrate blocks for quality assurance and control through design of curriculum content; quality assurance and improvement; learning, teaching, and assessment; management of programme and operations; and student guidance and support.
Five-phase TQM implementation model	Motwani and Kumar (1997), USA	• The TQM implementation in institutions is determined via these five phases: deciding; preparing; starting; expanding or integrating; and evaluating.

To sum up the above and deduce a conclusion, Srikanthan and Dalrymple (2007) tackled an approach to quality management in higher education through which, they differentiated between two types of processes:

(1) The learning and teaching process through education and research activities;

(2) And the services offered to the students: academically in for example; enrolment, and library services, or managerial in cafeterias, and recreation areas.

Finally, Yorke (1997) declared several notions for quality management with no equivalence in higher education:

- Error prevention and lessening alteration;
- Managerial responsibility for quality;
- Set of standards reflecting customer requirements; and
- The empowerment of staff for quality enhancement;

2.11 NEW MODEL DEVELOPMENT

Massy (2003) claimed that the simplistic model application drawn from manufacturing sector (e.g. ISO, TQM, and EFQM) in higher education is questionable for quality improvement. The implementation of these formal quality management models could not be adjusted to the core educational processes. Therefor, there is a need to explain these educational processes through the demonstration of the following:

- The definition of educational quality in reference to student outcomes;

- The focus on the teaching operation;
- The replacement of low-cost resources instead of high- cost ones wherever possible without affecting quality;
- The compliance of the department curriculum with the educational processes;
- The collaboration in accomplishing mutual involvement and support;
- The identification of best practices;
- And the prioritization of making improvement.

A measurement process is essential to improve the educational quality in universities. This process should ensure the evalaution of the performance of university operation, the enhencme of its weaknesses, and the evaluation of its administration (Chen et al., 2009).

The provision of in-depth knowledge, targeting academic development, students‟ education, and the coordination of national development demands reflect the vital objectives of universities (Johnes and Taylor, 1990). The fundamental functions of a university are mainly research, teaching, and scholarship (Tang and Zairi, 1998). While Perkins (1973) mentioned that, the three principal functions of a university involve education, service, and research. Donald (1984) assumed that universities should launch their Performance Measurement Indicators grounded on these functions to assess performance in reference to the allocation of resources. Thus, measurement would support universities in improving education quality, fulfilling the demands of their customers (i.e. students) and attaining their responsibilities.

2.11.1 Quality Management Model for Education (QME) Components

Many researchers have characterised the basic features of a general educational quality model in the following:

- Empowering students to contribute in effective actions and enrich this characteristic in all programmes (Srinkanthan & Dalrymple, 2007; Bowden and Marton, 1998).
- It is so crucial to generate tangible mechanisms to sustain the commitment for progress stimulation (Tierney, 1999).
- Distinguished qualified programmes should be collaborated within collegial and helpful cultures encouraging extensive participation (Haworth and Conrad, 1997).
- There should be a “transformation” process between the learners and the institution to take into consideration cognitive transcendence, not only the provision of relevant

information but also the perception of the subject implication under study (Harvey and Knight, 1996).

2.11.2 Educational Process Basic Parties

Universities have to acknowledge their "customers" and look for their retention because they are the principal reason for their presence hence, make their best to remain on good terms with students, staff, companies, and society in wide-ranging. Figure (2-12) illustrates the main parties that contribute in the educational process in order to achieve continual improvement.

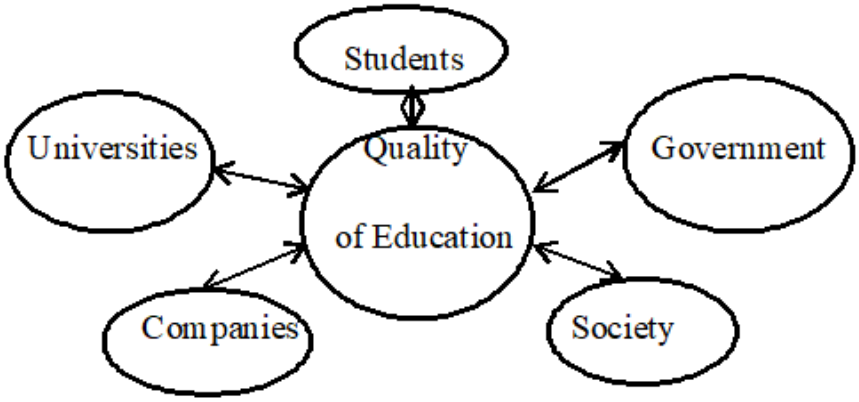


Figure (2-12): Parties Involved in the Quality Management of Education; Source: (Gueorguie, 2006)

The most important customers of schools, colleges, and universities are the students. Moreover, the university students are categorized into three types of degrees: bachelor, master and doctorate in the existing educational system nowadays. Thus, the different perspectives about students need further elaboration.

2.11.3 Customer-Oriented Approach

Emery, Kramer and Tian (2001) referred to this approach as the old proverb of marketing entitled "the customer is always right"; requiring better accessibility of professors to students; keeping intensive relationships with students; offering faster response to students; and conveying curriculum, which is best fitting for the fulfilment of the students‟ requirements. Bagley and Foxman (1997) exemplified that the both the instructors and students got informed that due to the reason that the course was sold to the students, they possess the right to declare their goal of taking the course and define the way of attaining this goal. In other words, the students construct their own syllabi in such customer-oriented courses through the

determination of the course objectives, textbook selection, assignments scores, and even time spent for covering each topic. The course syllabus is viewed as a living document, which could be changing in accordance to the student needs and their objectives. Emery, Kramer and Tian (2001) further indicated that most customer-oriented schools do not follow these excessive methods, they only adopt this type of philosophy in the policies of school represented in: academic advising; attendance; course drop dates and procedures; evaluation; office hours; and student appeal.

Bailey and Dangerfield (2000) demonstrated that the main business problem remains in: (1) the unlimited demands that corporations acquire from fresh graduates looking for job opprtunities, (2) as long as the students, alumni, and parents expectations, (3) in addition to scarce resources that school leaders have to cope with. In parallel, faculties are always looking for new technology fund, promotions affording, new programs, and supplementary faculty members.

Sacks (1996) suggested that this perception of slowly feeding of students with the required knowledge‟s will cause a poor educational quality with less equipped students less at the workplace. Albanese (1999) further added that the students should not be allowed to select the topics, which must be included in the curriculum, nor the grades that would be taken. Similarly, like the bankers, they do not give their customers the opportunity of determining the interest rate. Otherwise, the educational quality of the offered business program would not be promoted to the appropriate level of meeting the professional requirements of employers. Hence, it is of major significance that the trained academics develop the effectiveness measurements as well as the learning objectives, specically in the process of design a preparatory professional program.

Although it is beneficial for schools of business to adopt whatever means to market education to students, criticisms state that these efforts might demoralise the educational standards (Jones, 1997). Since the concept of "customer is always right" might be inconsistent and even discordant with the students' needs.

Furthermore, Soutar and Turner (2002) mentioned several items that students must take into consideration when establishing their preferences for a specific private university such as:

- The desired type of courses;

- The environment of the campus;
- The institutional academic reputation;
- The staff members‟ teaching quality;
- The u type of university;

Besides personal items, such as:

- Long way distance from household;
- The opinions of their families opinion about each university; and
- The willingness of their friends whether to apply with them for the same university or not.

They further concluded that the academic reputation, course appropriateness, job prospects and quality of teaching represent the four utmost vital determinants of university preference (Soutar & Turner, 2002).

Another research implemented by Tsinidu, et al. (2010) tried to formulate and assess the dimensions for the measurement of the service quality in higher education in alignment with the continuing undergraduate taught programs and the students‟ preferences within the offered educational services. As well, their study aimed at the analysis of the defining factors of the educational quality, and the extent of fulfilment the students‟ expectations and the investigation of the demographic factors affecting the differentiation in students‟ perceptions. They applied the AHP (Analytical Hierarchical process) in order to recognise the determinants of the quality for educational services in higher education institutions in Greece.

2.11.4 Product-Oriented Approach

Business schools must recognise the requirements of the business world in order to fulfil the requirements of real business communities (AACSB, 1999). The following dimensions can describe students as products:

- The integration of all resources throughout the educational process contributes to their transformation; and
- They are considered as one of the means that he external environment accordingly, in particular corporate employers, assesses the school as a prospective supplier for the needs of upcoming human resource.

When a higher education institution embraces the product approach, it should assure their product quality through the appropriate design of policies and procedures and monitoring of processes that fulfils the needs of their markets throughout the system. In a product-focused approach, faculty becomes first the engineers who develop significant and up-to-date course syllabi, then the producers who guide and monitor the students till the mastering of the course concepts and theories. In addition, quality controllers of the system who objectively seek the measurement of students' achievements, and the refinement of those less qualified products in anticipation of encountering the required performance criteria (Emery, Kramer and Tian, 2001).

According to Vaill (2000), student should not be thought of as a customer from a profit oriented business perspective due to the conflict the word customer may cause for the following reasons:

a- Education is obviously perceived as a service, not as a product, so the product mode of thinking when conducting a business could not be comprehended in a service endeavour.
b- Businesses race for getting and sustaining customers, thus any university targeting best students may lead to overstated claims of insufficient performance in contradiction of actual inquiry of students to acquire well education.
c- In the educational process, student‟s activity and contribution are required while the amount of work for customer participation is lessened in businesses.
d- The students‟ characteristics differ from time to time, they are changing, they do become more discriminating and sophisticated whereas the conventional customer's needs and expectations are usually more constant and stable. The supposition that students and professors never change is unreliable with the objectives of education.
e- Students are required to learn in teams and get involved in mutual interaction with each other and with faculty. While the value of products or services offered by businesses do not rely on customer communication with each other except in rare instances.
f- Students undergo a relatively rigorous qualifying process to contribute in the educational activity, whereas the pre-qualifications and experience needed from the customer in business seems to be minimized before partaking of its products and services.
g- The perception of education represents a complex interrelation of several systems involving students, professors, physical facilities, world events, time, and other complex

social relationships. Such systemic correlations should be organised as much as possible but customer relations in businesses could not be ineffective.

h- Most commonly, third-party payers like parents, employers, foundations, government sponsor students in universities, which is not the case in businesses; customers directly pay the cost of the products or services they are buying.

As can be seen from the above justification that nevertheless these previous illustrated views differ and do have potential contention, they are beneficial for investigating synergistic strategies for quality improvement. Typically, the argument is not about which objective is more appropriate, but about the relative importance, that the objective should support in reference to other desirable objectives. If properly applied, the market correspondence would find better techniques to deliver a higher quality of education to students, to graduate more skilled well-practiced workers for employers, and even to develop more accountable citizens for the society.

2.12 THEORETICAL BASES FOR FACILITIES MANAGEMENT IN HE

Researchers mention that the unavailability/ insufficiency of facilities have major effect on students‟ performance and lecturers‟ performance, in higher education academics. Facilities defined as design and development of materials in order to serve certain and accurate purposes. There are many different types of facilities regarding to the educational academics system, which make the educational process smoothed (Knirk, 1992).

There are two types of Facilities non-physical and physical facilities. The infrastructures of the education are physical possessions and facilities, which participate direct/indirect way to the education process. To ensure effective implementations of objectives in educational academics , the previous mentioned facilities must be well managed on high level of quality starting from the level of planning, through the development and implementation, (Knirk, 1992).

Enaohwo (2003) urged that academic physical assets and facilities quality assurance system could only be guaranteed if the system guidelines are followed. Therefor, the development of infrastructural must make control for adaptability or probability alteration, user‟s demands flexibility, students‟ accessibility to, society and employees in reference to clean environment and aesthetic.

Examinations into the operation through which future students can determine their option of university choices have increased. The influence of facilities on student option of university selection was introduced in a study done by Price, Matzdorf, Smith and Agahi (2003). Sutiable sample size must be used with the survey questionnaire, with forum members‟ in consultation. A survey instrument was developed and tested on the 1999 student intake. The questionnaire consists of 87 closed questions in accordance to their importance by means of five Likert scale. Twelve questioning modules as designed to achieve the following: university type, city/twon reputation, housings, education, facilities, security process of the university, transportion system, facilities for social and sporting activities, facilities for childcare, and university environment. The questionnaire responses were coded in 2000 and 2001 then the analysis process was carried out. Table (2-6) shows the first seven items that use average rating of 4 or higher in the two questionnaires. The authors concluded that the questionnaire respondents had a greater importance to factors they were more satisfied. The students‟ choice is what university must have if it is to attract students. Many facilities can differentiate a particular institution.

Table (2-6): Average Ratings of 4 or Higher in 2 Years Surveys; Source: (Price, Matzdorf, Smith & Agahi, 2003)

Item	2000 average	2000 ranking	2001 average	2001 ranking
Desire of course	4.84	1	4.8	1
Computers availability	4.48	2	4.41	2
Library facilities quality	4.47	3	4.41	3
Good teaching reputation	4.35	4	4.29	4
Quiet areas (e.g. library) availability	4.23	5	4.22	5
Availability of self-study area	4.16	6	4.21	6
Quality of public transport	4.07	7	4.13	7
Friendliness toward students	4.05	8	4.04	8
Catering outlets pricelists	4.01	9	4.00	13
Accommodation cleanliness	4.00	10	3.92	15

In 2005, William Daigneau, vice president of Texas University, specified five basic trends for facilities of university managers to consider:

1) Changes in commuity specifically the demographics of students

Facilities Managers must hold this and combine their strategy and identity regarding to the institutional into their tangible resources and authorities to their maintenance department.

2) *Economics, Access and Efficiency*

To realize a more attainable and effective educational system, higher educational academics must understand their target market and the barriers that students face in gai**n**ing access and in succeeding in their studies.

3) *Technology and Innovation*

The demand for technology increased by the students, especially social media and mobile applications, and student‟s will soon ask for ease of access, dependable technical support, quick responses from academics and chances to comunicate in iteractive manner with collegues, academic and professionals within their collegae. Many virtual spaces are developed such as the lectures can taken at any time and students want to take in their free time and they can interact at their own appropriateness.

4) Government and its role to be considered

The facilities managers must take the impact of government on the academic offers into considerations and if the received grants will be enough in creating an enabling environment.

5) *Environmental Issues and Sustainability*

When we talk about sustainable development approaches in the facilities and buildings, facilities managers should be depend on expertise that put in his mind the surrounding environmental and its effect on the buildings by create a teamwork consisting of architects, engineers, and maintainers.

Some studies mentioned that the “incomplete facilities” considered one of the big threats to higher education success. The research suggested that immediate actions must be taken and additionally the realization that leadership is defined as the basic ingredient that ensure future success of higher education and help eliminate its threats (Goldstein, 2006). Two of the basic alteration drivers, lack of resources and information technology, are figured as well in the most important ten critical items that higher education facilities professionals face, according to The Association of Higher Education Facilities Officers in the United States (see Table 2-7). There is no question face the alteration needs and means for education‟s delivery, managers and planners of the institutional need to reconsider the way of design planning, and mangement made to the higher education facilities.

Table (2-7): Top Ten Critical Higher Education Facilities; Source: (Goldstein, 2006)

1. Poor resources and affordability; 2. Accountability and measurement of performance 3. Services offered to customer; 4. Information technology; 5. laboratory and classroom developemtn in the future;	6. Ownership's total cost and Facility reinvestment; 7. Eployees issues; 8. Sustainability; 9. Energy management; 10. And safety, security and business continuity.
Source: APPA (Association of Higher Education Facilities Officers) (2006), University Facilities Respond to the Changing Landscape of Higher Education, APPA, Washington, DC.	

Makhanya (2010) concluded that higher education trends show an increase from 19% in year 2000 to 26% in year 2007. According to this increase, the students number also increased by 53%. To address the demands increases the author specified an increasing in higher education private section with about 30% of the global students enrolled in such academics. The increase in facilities management becoming a critical managerial issue at the level of operation and management. Therefore, the author suggested that managers of facilities managers and employess in higher education field must be effective, experienced, and analytical thinkers. He also proposed that managers of the facilities must be aware about external and internal and environments factors of the higher education institution to which they are hired in the following context:

- Facilities management external context:
  - Facilities management within the academic play a basic role and it will require that good higher education‟s management system.
  - Managers of the facilities must understand that they are managing effective and demanding increasing field.
  - Managers of the facilities must understand the impact of outsider trends on the strategic and operational facilities management system.
- Facilities management of external governance
  - In order to understand the strategies influnce on the academic‟s facilities, the managers of the facilities must have an effective role in this strategy by providing sufficient inputs.
  - Managers at executive management must backing the chief role of facilities and allow space to creative and innovative exploration.

- Managers of the facilities must define opportunities/weakness to take positive interaction to the academy.
- Managerial‟s positions in academic field must include managers of the facilities in their planning process and vice versa.

The Quality Standard QS define the rating system of a university as the system that come up with an overall system that can be used for comparing and rating universities‟ performance by means of a broad spectrum of criteria. Classifications used are regarding to research, teaching, graduate employability and internationalization (Abd Elghany and Elharakany, 2017).

2.13 SUMMARY

This chapter contain two integrated sections. The first section presents the historical of Higher Education Quality development for the exhibition of the theoretical perspective related to the quality and its management models in higher education for the reason of underlining the importance of the fulfilment of the students‟ needs and expectations. Related studies confirmed that the continuous improvement of quality in higher education should be evaluated in order to achieve student satisfaction.

Then the second part examined previous studies made to investigate the significance of higher education facility management system, and its items such as; efficiency features higher education‟s quality, are impelementaions actions in term of libraries, facilities, computer labs, facilities for sprots activities, student accommodation and hospital condidered to be the most important criteria used when evaluating university performance. Facilities more investment needs to be more organized and managers‟of the facilities and employees in higher education need to be effective, experts, and analytical thinkers. Managers in this field need support to take the right decision when managing facilities.

CHAPTER THREE

DECISION SUPPORT SYSTEMS

3.1 INTRODUCTION

As the research project aims at the investigation of the consistent linkage between facilities management and higher education‟s quality precepition, chapter three will concentrate on the professional literature related to the field of decision support systems in higher education. The analysis and complex problem solving will be done by means of a dynamics system based on a computer-aided method through policy design and analysis, and thus potentially aiding in the decision making process regarded to higher education‟s quality with respect to facility management. Therefore, previous researches that use the System Dynamics approach in educational segment will be presented and the conclusion part at the end of this chapter will summarize the importance of reviewing the previous studies.

3.2 THEORETICAL BASIS FOR DECISION SUPPORT SYSTEMS AND SYSTEM DYNAMICS

Recently the higher education consists of many complicated operations, which result in a large amount of data. Universities have grown into becoming more and more reliant on the collecting, processing, and storing of that immense volume of education data. Good decisions comprise the production of a few software tools available to support the decision-making process in higher education. Decision-making in the planning of higher education encompasses the analysis of huge data volume that is originated from different and numerous systems. This part is oriented to providing numerous researches related to decision support systems used in higher education, and then the System Dynamics, which can be considered as an important tool to help high education manager to make decision by means of the the available data analysis will be reviewed.

3.2.1 Decision Support Systems

The data abundance makes it problematic and challenging to discover the precise relevant and useful information that is essential for the decision-making process in higher education (Susnea, 2013). Decision support systems will help to guarantee a scientific base to help the decision makers and participate in the enhancement of the quality management system in the higher education.

Mannesmann and Scholl (2007) presented a work in the field of system‟s of decision support for the management of educational capacity utilization. The study proposed a methodology for the assessment of educational capacity and preparing a plan of its utilization and distribution, which is impelemented as a decision support system that permits the evaluation and simulation of several proposals and scenario. The motivation of the work was to substitute the out-dated official proceudres for calulating the capacity of education system in reference to students‟ number. The authors investigated the problem of providing trustworthy decision support to the process of achieving balance between the demand of educational and its supply regarding to the universities. The system proposed has been implemented as a database enabled web application as the multi-layered client server architecture best fulfilling the DSS requirements with a high convenience and access of multi-users. In the simulation mode, the user must be supplied with a copy of data input to test the wanted scenario. The authors concluded that the academic structure model is modelled as a supply-demand connection between students and teaching resources. They suggested that future work on the project could be directed towards refining the methodology.

Later, Hai and Esichaikul (2008) presented a work in the field of web-based decision support system in higher education. They suggested that web-based decision support systems can be practised as a strategic planning and evaluating tool for universities. Based on Analytic Hierarchy Process (AHP) their study focused on the use of ISO 9000 factors in higher education to develop Web-based DSS application for its implementation in a university in Vietnam. The architecture of the web-based DSS application is shown in figure (3-1) below.

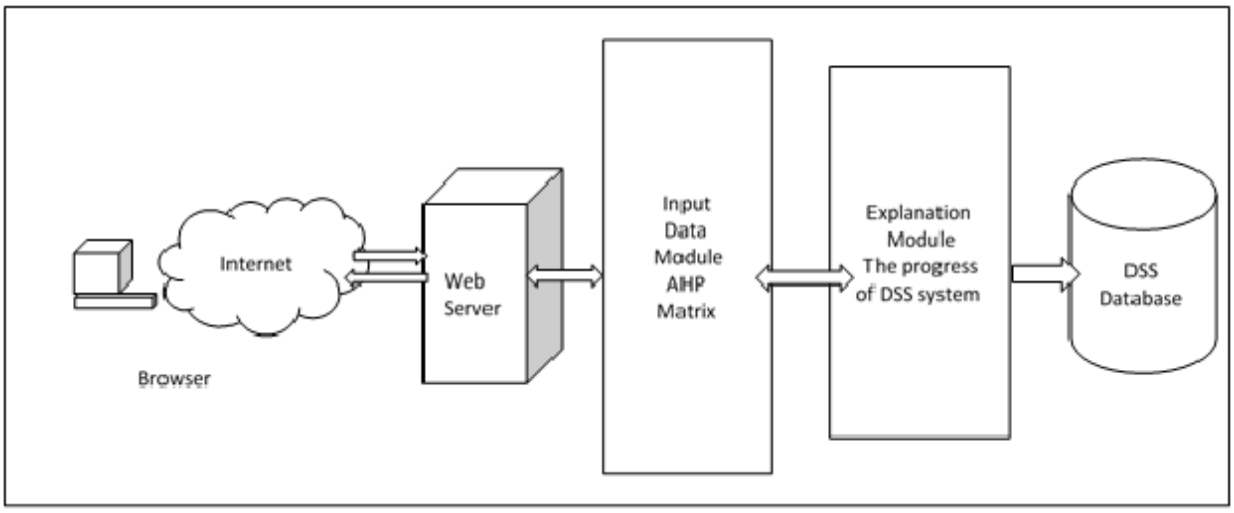


Figure (3-1): The Architecture of web-based DSS application; Source: (Hai & Esichaikul, 2008)

According to the case study, the authors stated that the work contributed in valuable evaluation for educational management by means of the use ISO 9000 factors. Web based DSS application onsidered one of the good solution; it gives the opportunity for a decision maker to easily construct a new model application on the Intranet/Internet. They concluded that AHP model using ISO factors can be practised in various types of decision making in educational management such as predicting, evaluating, and planning.

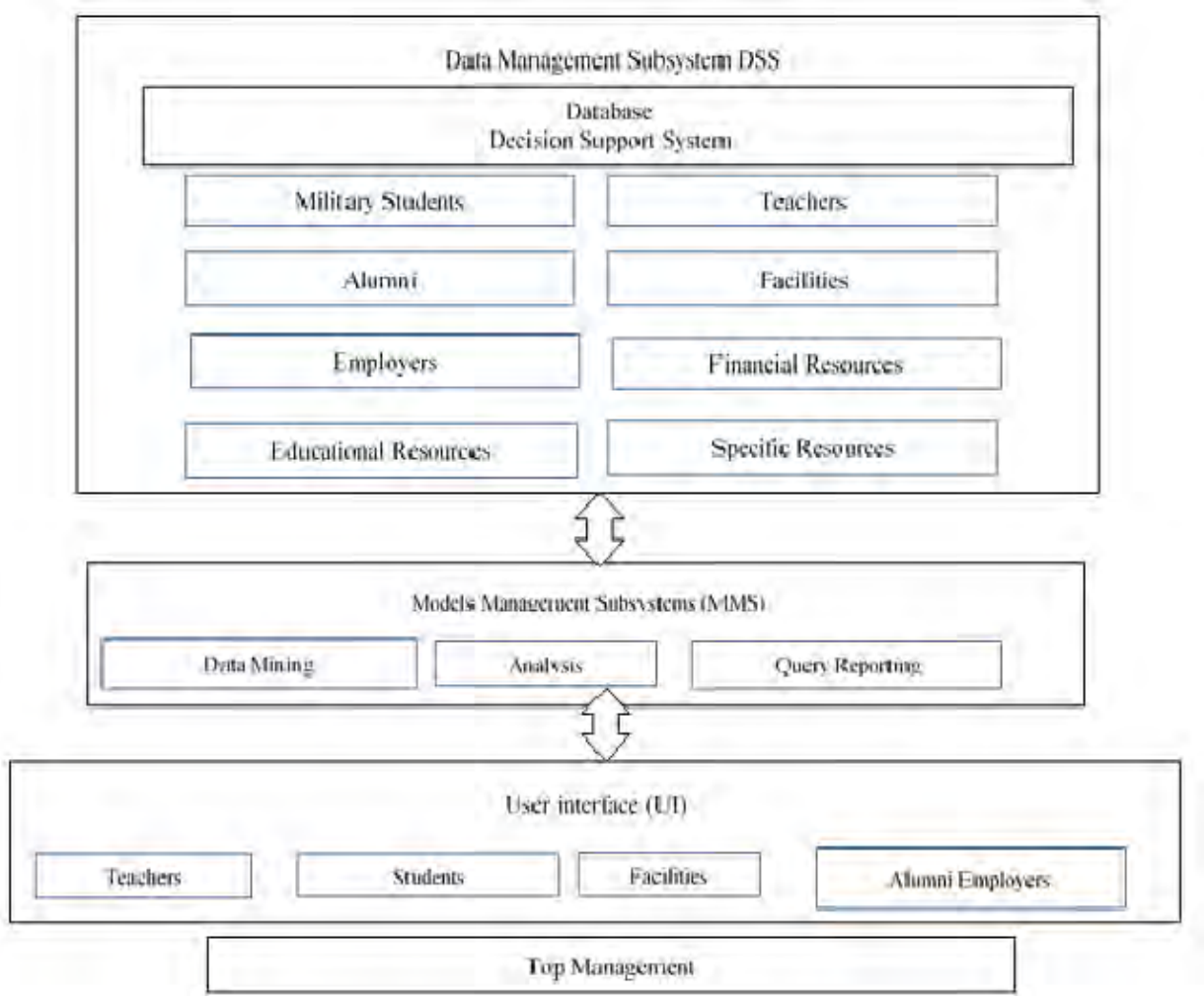


Figure (3-2): IDSS Components; Source: (Susnea, 2013)

A recent research by Susnea (2013) proposed an intelligent decision support system model of to improve the operation of decision-making in the universities. The proposed model is shown as shown in figure (3-2) above. The study goal was to build a support system that would offer a scientific basis for the decision-making process in higher education system and could participate in the enhancement of the higher education quality. As can be seen from the figure, the model proposed by the study is consisted of three subsystems contributing in an integrative manner for the quality services provision as follows:

- The Data Management Subsystem (DMS) to provide the required data;
- The Model Management Subsystem (MMS), which is a software package to generate models; and
- The User Interface (UI) to facilitate communication and extract of data.

The database will include the following entities: alumni, students, employers, teachers, facilities, financial resources, educational resources, specific resources and e-learning. The author concluded that the important step in the academic field is the development of an integrated IT system that will help the decision makers. The introudced model help in the increase of the management decisions.

3.2.2 System Dynamics

The *System Dynamics* method represents a holistic practice of problem solving in real-time scenarios. Computer simulating modelling method is a strong methodology for putting into frame, analysing, and deliberating complicated issues and difficulties. System Dynamics modelling is regularly the systemic thinking approach‟s background and has grown into an organisational managerial development paradigm. Many researchers were concerned with introducing the System Dynamics as a way of system thinking.

Simulation is considered as a strong tool to be used to utilised to investigate problematic systems. Simulation concept is to develop a complex system model and then manipulate that model for the observation of the results. The model must be an abstraction of the real system. System Dynamics, created by Professor Jay Forrester (1950), can be considered as a thinking way about the forthcoming, concentrating on “stocks” and “flows” within processes in addition to the interrelations between them (refer to figure 3-3).

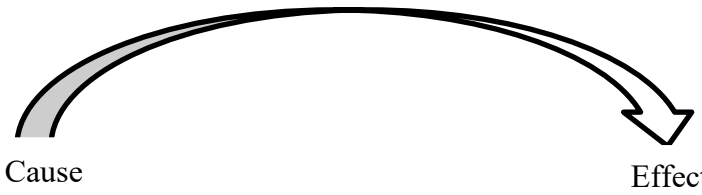


Figure (3-3): Cause and Effect Relationship; Source: (Forrester (1950) in Albin, 1997)

System Dynamics modelling is often regarded as the background of a systemic thinking approach to enable the exploration of how a system will evolve over time. The causality chains are gathered in a occasional loop diagram. Based on a study done by Albin (1997),

developing a System Dynamics Model is a sequence of written papers to clarify the developing process of the model. The author described his paper as the chief in the sequence trying to explain the early phase of the model developing process that is called *conceptualization*, which is consisting of these steps:

1. The definition of the model‟s purpose;
2. The demonstration of its boundaries and the identification of its key variables;
3. The description of its behaviour (graphing components over time as reference mode); and
4. The portrayal of its main mechanisms and the system‟s‟ feedback loops through the use of causal loops diagrams or stock and flows diagrams.

A study presented by Kennedy (1998) illustrating a System Dynamics model for the understanding and the controlling quality problems in universities. He described and reported a pilot study in the school of computing, at South Bank University for the evaluation of the construction feasibility of a model for a complex, independent set of variables regarding the quality management in higher education.

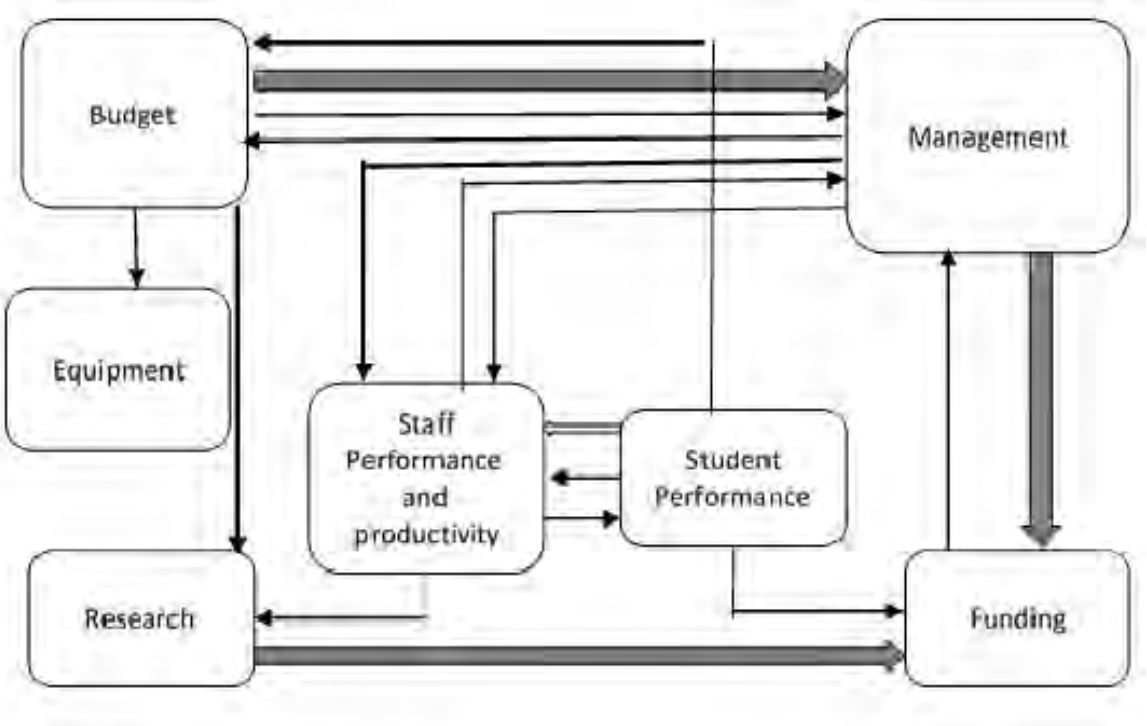


Figure (3-4): Simulation Model Sectors; Source: (Kennedy, 1998)

The author used the higher education quality management factors developed by Ashworth and Harvey (1994) for the quality measurement in higher educational institutions. The model includes the following:

- Curriculum;
- Funding;
- Learning & Teaching;
- Management;
- Organisational resources;
- Quality control policies;
- Research; and
- Students‟ support

The model development included three stages. Stage one was done with the effect diagram to better understand the key attributes having an effect on the universities as a whole, to be able to formulate the relationships with one another. The second step was concerned with the construction of the prototyping model via the utilisation of the information abstained from the influence diagram created in step one. The third step involved the data collection needed for the finalisation of the model. The prototyping model built in the second step has seven sectors; Figure (3-4) displays these simulation sectors as follows:

- Administrative Support Quality;
- Budget;
- Equipment;
- Funding;
- Research Quality;
- Staff performance and productivity; and
- Student performance.

The author concluded that the evaluation of the quality management process in South Bank University gave an initial point to the developing process of the model. The usage of System Dynamics approach would empower the building of a model, which permits the stimulating interaction and experimentation of various scenarios. This will allow the staff and management to explore system‟s changes regarding to the real implementation of those changes.

Another study addressing the area of performance measurement in higher education using System Dynamics was presented later (Temsahi, 2001). The basic goal of the study was to create a systematic approach to performance measurement, which contains aspect from soft

systems, System Dynamics and viable systems in measuring the system performance. The author used three basic assumptions:

- Every entity to be measured can be treated as a system;
- A system has well-defined purpose;
- A model or simulation can be built to represent the system under considerations.

Based on the study, no methodology was found to satisfy criteria assessed, so a new methodology was introduced. The methodology proposed was applied to two university departments one in the UK and one in Egypt. The methodology proposed is summarized in five stages:

1. Dealing with complexity;
2. Building qualitative model;
3. Measure performance;
4. Apply the measures at several levels of recursion.

The author suggested that the new methodology can deal with complexity and different types of measurements, and that the use of System Dynamics automatically guarantees that feedback and non-linearity can be considered. The output of System Dynamics model is dynamic graphs so a measurement over time automatically can be produced. Finally, the author concluded that the research was successful in using systems ideas to derive a new methodology for measuring performance using System Dynamics to handle holistic thinking, feedback, complexity, dynamics and non-linearity. The methodology was easily transferred from the UK to Egypt showing a true generic nature. Finally, the author confirmed that System Dynamics is designed to handle non-linearity.

In 2003, Kennedy and Clare examined issues in developing System Dynamics models for the improvement of managing resources in higher education. The authors discussed factors, which should be merged into a system dynamic model that is designed for the assistance of policy analysis concerning the resource management issues. They used four distinct groups of university‟s stakeholders according to Clare (1995): the students of the institutions, the employers of graduates and diplomats, the government, local government, government agencies and the training enterprises. As future contribution of System Dynamics to higher education resource management, they presented some prototype examples as a basis for discussion. The potential contribution of system dynamic to the information systems of the higher education‟mangement appear to take place in three parts:

- The replication of existing models that were originally developed (Kennedy, 1997a, Kennedy, 1997b);
- It is possible to produce System Dynamics models of concerned issues presented in figure (3-5); and
- Thirdly, business models illustrating higher education management processes may be developed before and after a proposed change in a process.

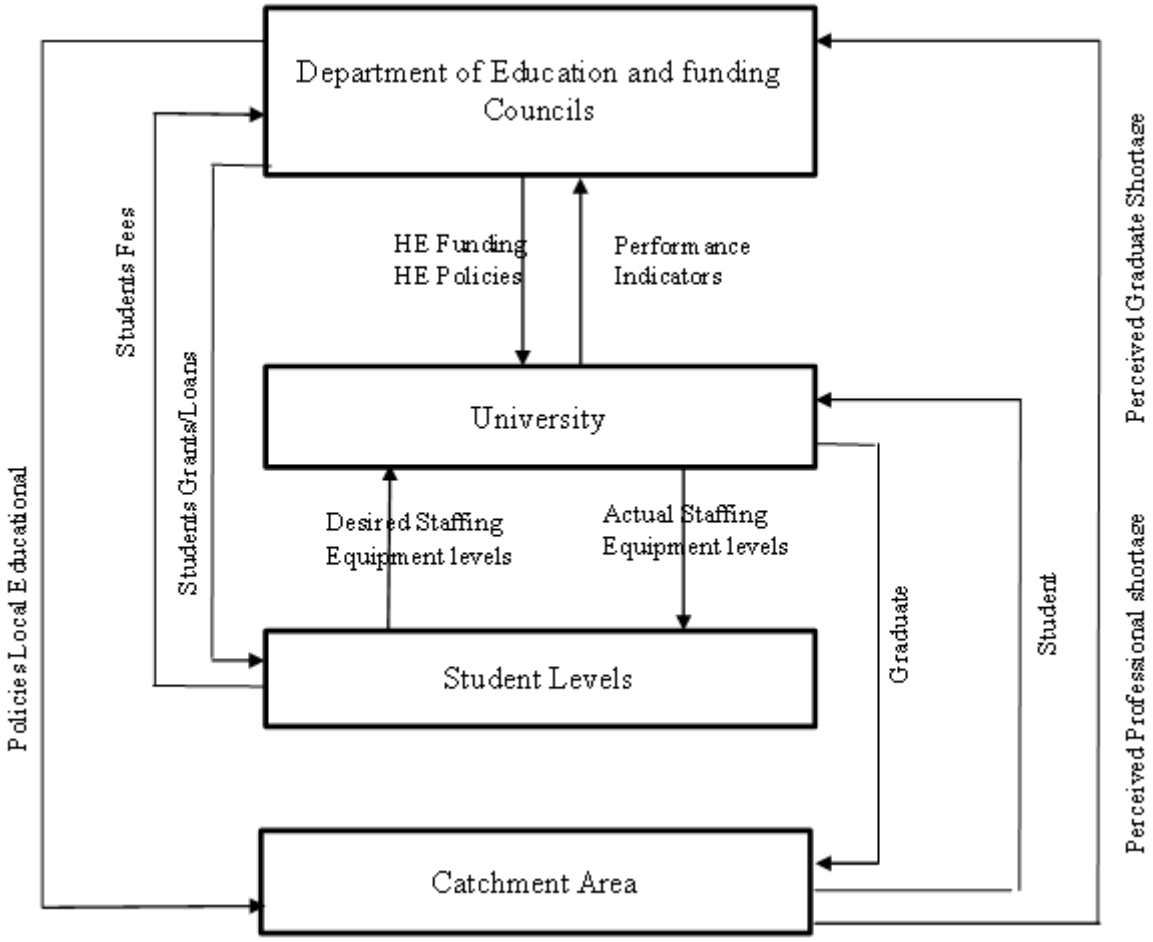


Figure (3-5): Block Diagram of Major Feedback Structure in Higher Educational Management at an Institutional level; Source: (Kennedy, 1997a, Kennedy, 1997b)

The authors highlighted that a system dynamic model of the process of allocating resources would give a helping hand to the management in the investigation of the influence of precise policies before their implementation. Therefor, there is a potential role of system dynamic in dealing with the available ever-reducing resources, and mounting standards of quality for institutions in higher education worldwide. Based on the discussion presented in their study, they concluded that the following three research themes would need further examination:

- Higher education planning;
- Appropriateness of different styles of System Dynamics modelling;
- The International/National, Regional/Cluster, Institutional/University.

On the other hand, Williams (2005) demonstrated that the System Dynamics methods are divide into two basic methods. One method depend on mapping the dynamic correlations and then using different techniques in order to understand any possible outcomes regarding to those correlations, and the other is to simulate the dynamic correlations to can discover the results of different quantities of inputs, timing, delay and feedback. The authors presented the following steps for the classic system dynamic process:

- Problem identification;
- Prepare a dynamic hypotheses to explain the reason of the problem;
- Build the model at the root of the system;
- Ensure the model reflects the real world (or explore similar models already tested);
- Play around the model to understand the issue;
- Draw conclusions.

Later, an investigation work was presented to participate to the tools‟ development for managing challenges in higher education filed (Oyo, Williams & Barendsen, 2008). The study was investigating the higher education‟ dynamics funding and resulting influence of part-time teaching, research productivity, staff in reference to student ratios, staff development, and consequently the deliverd quality, by means of using a simulating System Dynamics model. The authors suggested that the complex dynamics underpinning funding and quality relationship cannot be addressed by linear methods. The study adopted the System Dynamics approach to investigate the different views in dynamic systems in higher education. Conducting a primary survey over the issues of quality management, from two foremost Ugandan private universities and two public universities as the foundation for the model, they asserted that the functions of the faculty are commonly outlined in:

- Having full time staff;
- Providing wide range of degree programmes starting from undergraduate to PhD;
- Run with a fixed strategically planned student‟s capacity;
- The funding prospection in the research area and staff training; and
- The generation of income from internal activities.

Furthermore, the model used these three assumptions: minimum number of publications is obligatory, tuition from students should be assigned to small fraction of funds required for research and finally PhD holders of the faculty‟s academic staff in combination with research students should establish research groups. Based on hypothesising the dynamic behaviour, the entire model‟s sectors are shown in figure (3-6). The model includes five sectors: academic staff, funding and strategic planning, research and publication, students‟ enrolment, and teaching. Each sector has established influential factors that represent the real higher education environment and these influence diagrams were portrayed through presenting the stocks and flows of the model in the research study.

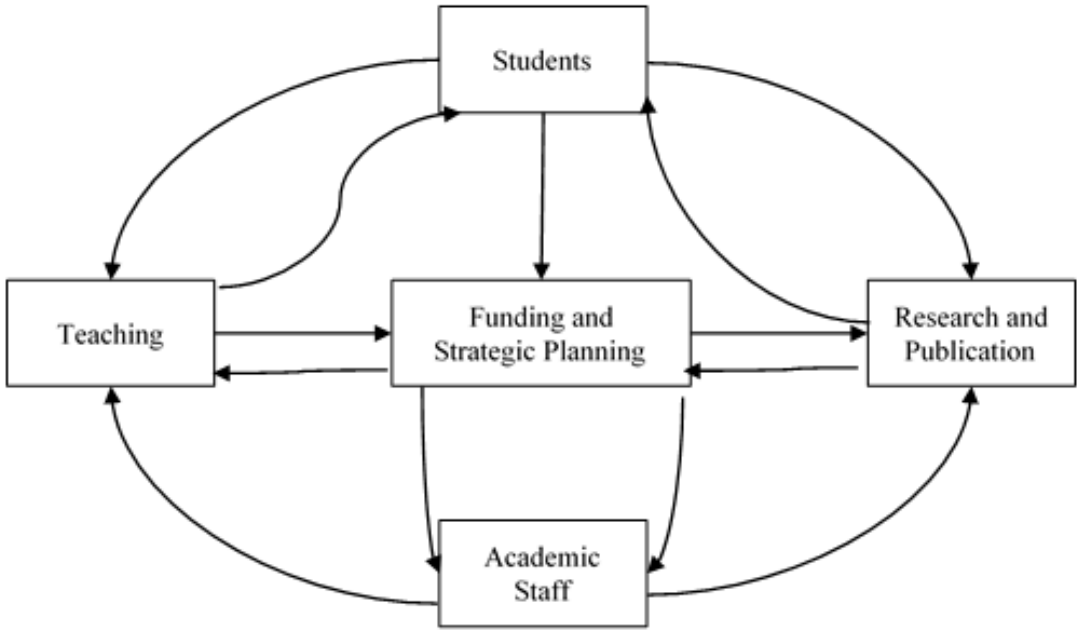


Figure (3-6): Main Model's Sectors for System Dynamics; Source: (Oyo, Williams & Barendsen 2008)

A recent study done by Hussein (2013) discussed the allocation of resources in higher education institutions built on genetic algorithms and System Dynamics. The author suggested that the quality requirements‟ costs embrace building and facilities, counselling, courses, legalism and morals, libraries and information centres, marketing, services provided to the students, research and environmental services, and scientific assessment The model proposed was based on the point of views of Kennedy (2009) and Hussein (2010). Figure (3-7) shows the proposed model encompassed several factors for providing worthwhile data to policy planning. For model accuracy‟s verification, the author used real data covering three years. The research objective was the optimisation of the design factors of the model. The author proposed the best budget distribution as shown in table (3-1).

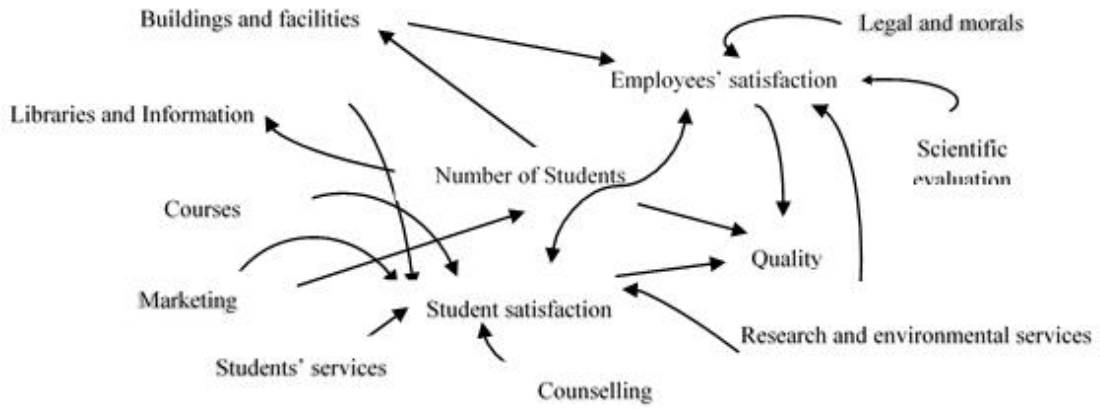


Figure (3-7): Supply Chain Causal Loop for Education Quality Control; Source: (Hussein, 2013)

Contrary to SWOT analysis and TOWS matrix, the author suggested that the System Dynamics could suggest occasional connections between variables, current and future analysis, and quantitative measures. The research also provided a comparison between the normal management of quality and its effect on quality. The suggested model offers an idea of what the outcome can be to the quality management planners if they modified the design factors (leverage points) for being able to maximise the educational quality.

Table (3-1): Best Budget Distribution According to the Study; Source: (Hussein, 2013)

Design factors	Building and facilities	Courses	Marketing	Counselling	Libraries, Information centres	Students" services	Research environmental services	Legal and moral	Scientific evaluation
1st year	37%	5%	8%	3%	11%	8%	7%	2%	4%
2nd year	32%	4%	6%	4%	11%	10%	12%	1%	5%
3rd year	26%	6%	5%	3%	13%	10%	11%	1%	4%

Another recent study presented the development of a third generation university strategic planning model (Skribans, Lektaniers & Merkuryev, 2013). It discussed the application of a of a simulating model that would permit the analysis of the third generation university"s strategies. The generic construction of the third generation university model proposed is shown in figure (3-8).

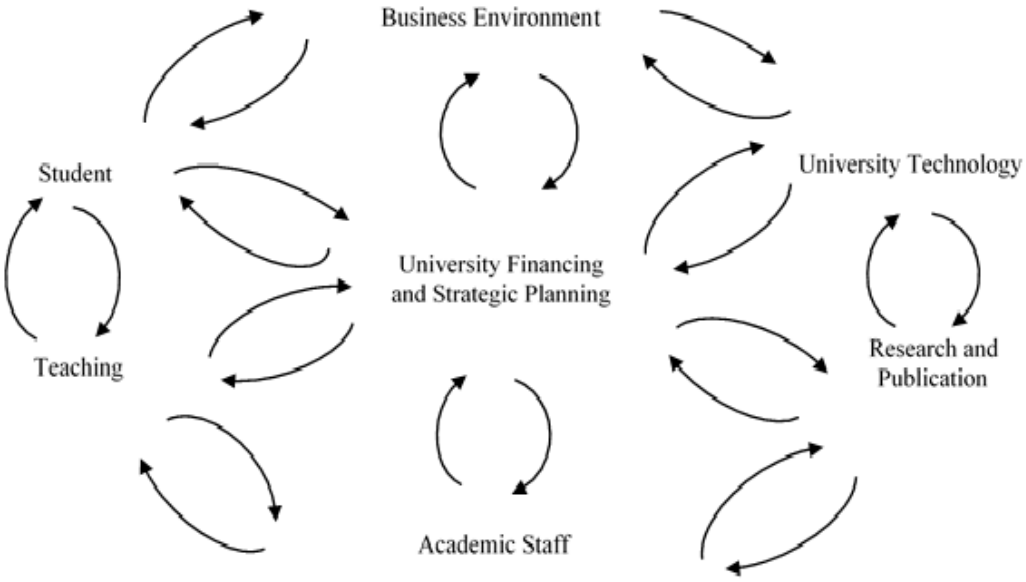


Figure (3-8): General Structure for the Third Generation University Model; Source:

(Skribans, Lektaniers & Merkuryev, 2013)

Their conceptual model shows important contibutions of the university (academic personnel, students), activities (learning, research), their interrelations, total financing and strategic planning. The authors revealed that the model developed is actually not for Riga University only, but also for all the world. Analysing practical implementation conformed that the universities‟ development depends on its capability for developing and managing novel technologies.

A more recent study proposed a System Dynamics model for the long-term planning of the undergraduate education in Brazil (Strauss & Borenstin, 2014). The authors developed a model founded on the quantitative data of higher education published by the MoE (INEP 2010), socioeconomics indicators and population information released by the Brazilian Institute of Geography and Statistics. The developed model followed the methodology offered by Sterman (2000). A preliminary causal loop diagram is presented in figure (3-9). Many scenario regardiong to the System Dynamics model proposed was implemented. The authors suggested that the study highlighted the significance of the fact that education affects the country development with regardiong to ecomnomy and social and the difficulties confronted in Brazil for the goals‟ achievement in the higher educational system.

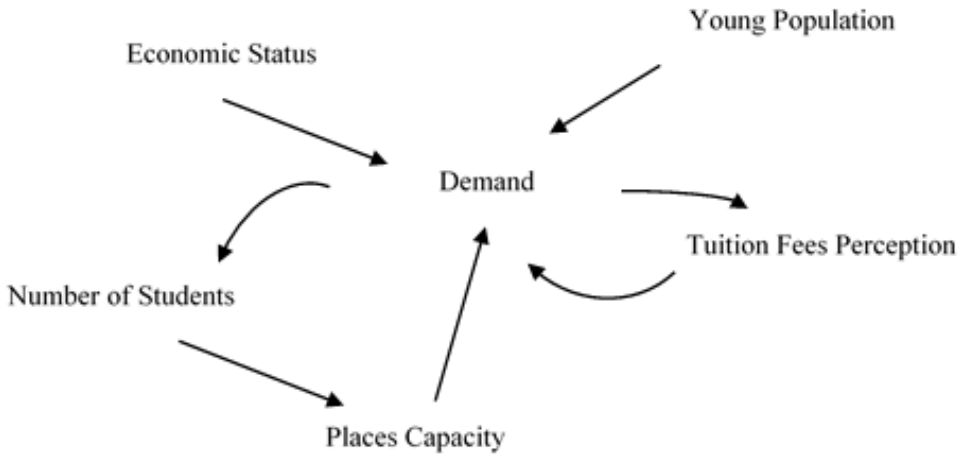


Figure (3- 9): A Preliminary Causal Loop Diagram for the Higher Education Private Sector; Source: (Strauss & Borenstin, 2014)

The authors stated that the objective of their study was the development of a System Dynamics model to assist managers in the analysis and better understanding of the dynamics of undergraduate higher education and the infulences of different policies, but the model proposed can be used in other countries encountering same problems in their higher education systems.

3.4 SUMMARY

This chapter examined decision support systems in the field of academic planning. As academic management is more concerned with the distribution of teaching resources for the support of the university‟s educational framework effectively, they need a tool to help in evaluating the link between facilities management and quality management in higher education. The process of decision-making regarding to the academic‟s planning field involve analysing extensively large volumes of data from multiple systems. Decision support system can be utilised as an evaluation tool as well as a strategic planning tool for higher education institutions. It is considered as an influential methodology and computer simulating modelling technique for the analysis and discussion of problematic and complicated issues. To conclude the implication of the theoretical previous effort reviewed on this chapter, the following consideration was deliberated while proceeding to conduct an exploratory study of a Decision Support System for facilities Management in Public and Private Universities in Egypt in order to measure the quality in those institutions.

CHATER FOUR

RESEARCH METHODOLOGY

4.1 INTRODUCTION

The present study focus on developing in order to investigates the relationship between university resource allocation in facilities management and the perceived quality of education in Egyptian universities. This chapter discusses the methodology employed for the research, which consists of four sections. The first section will discusse the research question utilised, the second section will review the research‟s methods theoretical basis for related to the research design, the third secion will depict the research strategy and the fourth section will describe the used methodology for data gathering and analysis to delineate the research structure of this thesis.

4.2 RESEARCH QUESTION CLARIFICATION

The research started from a desire to address the general question of quality management for optimized budget distribution to resources allocation. Simulation-modelling method are needed to prioritize the most influential universities‟ facilities that should be funded for maximizing the education quality emerges from the the higher education (HE) evolution in the developing countries in reaction to pressures of extremely quick increase of enrolment, physical‟s facilities relapsing, low library resources, poor scientific instruments, and incapable yet insufficient payment to th staff. This entailed an orientation phase where informal discussion with experts and colleagues proved to be helpful. Furthermore, exploratory desktop research helped to develop preliminary insight into the problem situation under study. The feedback gained in this early phase significantly helped to shape the study and to clarify the research design, methods and conceptualization of this research project.

Research Question

What are the key facilities that universities should support in order to attain the most cost effective budgeting plan for its development?

To answer this question, the conducted investigation was based on these generic assumptions:

- The well-planned budget plan for educational institutions influences the physical facilities that the university can provide and consequently affects the educational institutional

performance; hence, there exists a positive relationship between the physical facilities that the university can offer and the proficient allocation of resources in budget distribution.

- Management perception of effective allocation of resources might help for decision-making process of finding which university facility that must givien the priority in provision; accordingly, managerial logistics staff experience provides enormous contribution to the development of the university.

4.3 RESEARCH METHODS REVIEW

In this part, the different research approaches are overviewed to give a justification for the adopted pragmatic triangulated research approach. Creswell (2014) defines the broad research approach as the proposed plan in order to conduct the study involving the philosophy‟s intersection, study designs, and special methods (refer to figure (4-1) below). He further added that any researchers must think through the philosophical worldview presumptions sugesstions that they bring to the reserach, the design of the research must be related to this worldview, and the special steps of research that translate the approach into implementations.

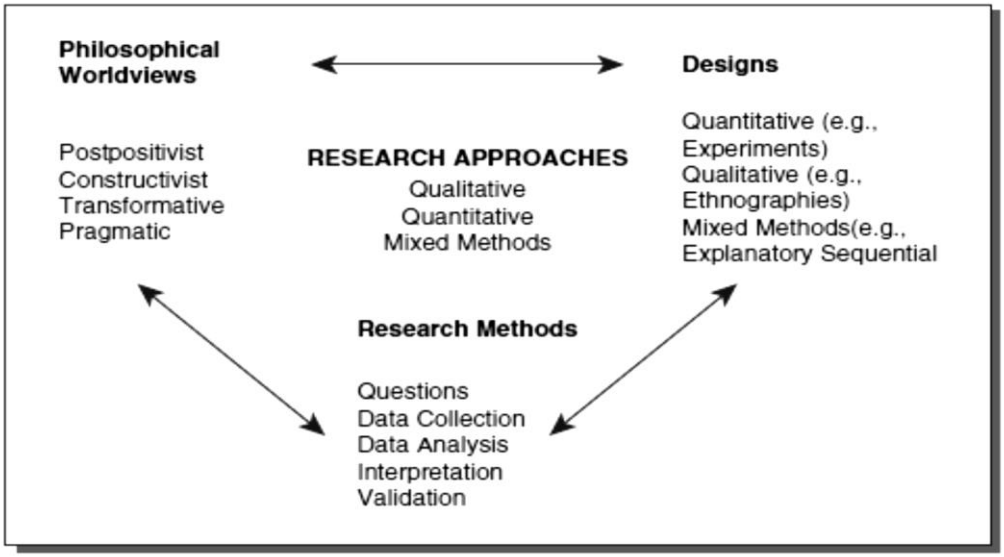


Figure (4-1): Research Framework – The Interconnections between Worldviews, Designs, and Methods; Source: (Creswell, 2014)

Guba (1990) termed the worldviews as the meaning of “a basic group of beliefs that guide action”. Others called them paradigms (Lincoln, Lynham, & Guba, 2011; Mertens, 2010); epistemologies and ontologies (Crotty, 1998), or broadly conceived as research methodologies (Neuman, 2009). Creswell (2014) highlighted that the most widely

worldviews deliberated in the literature are postpositivism, constructivism, and pragmatism. The subsequent sections give a thorough discussion about each.

The postpositivist tradition are cocluded by the 19th-century writers, such as Comte, Mill, Durkheim, Newton, and Locke (Smith, 1983). Recently Phillips and Burbules (2000) summarized its basic assumptions of this approach in the following. Study can defined as the process of making some new claims and then refining or giving-up some of them, which clarifies the start of most quantitative research are based on test of a theory. Knowledge is hypothetical, i.e. there is no absolute truth, and accordance the evidence that established in any sustdy is always deficient. Therefor, the researchers conclude that they do not prove a hypothesis; instead, they show that they cannot reject the hypothesis. The evidences, data and shape‟s knowledge rational considerations. In impelementation, the researcher gather information by means of instruments to measures by the participants in the study or by by the researcher through observations. Research always seeks to develop a real inter-correlated data serving on explain the situation of concern or describing the interested negative relationship. In quantitative researches, researchers pose the correlations between the variables in form of questions or hypotheses. In addition, objectivity is a basic feature where researchers must examine methods and conclusions for bias and standard of validity and reliability are important.

The owners of philosophic situations had unavoidable philosophy that reflects the need to define and evaluate the reasons that affect the results from experiments outputs. In addition, it is also reductionist in that the intent the thought into a small, discrete set to test, like the hypotheses variables and research questions are reduced. Accordingly, creating observations‟ numeric measures and studying the behaviour of individuals becomes vital for a postpositivist. There occur laws or theories governing the world, which need to be, validate and refined for the reason that the studied theories‟ are either supported or refuted, and then makes the required revisions and additional tests are conducted (Creswell, 2014).

Constructivism is often combined with interpretivism and it is take the form of qualitative approach of the study. The thoughts came from previous work of Berger and Luekmann‟s (1967), “*The Social Construction of Reality”*, and Lincoln and Guba‟s (1985), *Naturalistic Inquiry*. Recently, Lincoln, Lynham, & Guba (2011), Mertens (2010), and Crotty (1998) have recapitulated this approach as follows.

Human beings build their meanings when they deal with the world that they explaining. Open-ended questions are used by the researchers to enable the participants can exchange the point of views. Humans understand their engagement depending on their social and historical point of view therefor; qualitative researchers always want to understand the participants‟ the orientation through collecting the information by himself not any other ways. The researchers own experiences and backgrounds shape the humans‟ interpretation. The fundamental generation of meaning is always social, arising in and out of interaction with a human community. The qualitative research process is always inductive; the data collection processes are translated meaning (Crotty, 1998).

Creswell (2014) further illustrated that "individuals develop subjective meanings directed toward certain things where these meanings are varied and multiple, leading the researcher to look for the complexity of views rather than narrowing meanings into a few categories". The asked questions become broad and general to help the participants make a meaning to a specific situation, and many open-ended quaetions are better for good results, as the researcher listens carefully to what people actions in their life stuitations. Explanations are shaped through interactions with others, accordingly social constructivism, and through cultural historical norms operating in individuals‟ lives.

Pragmatism is derived from the work of Murphy (1990), Patton (1990), and Rorty (1990) (Cherryholmes, 1992). It is generating of actions, situations, and consequences instead of pervious circumstances and it is interested about applications and problems‟ solutions (Patton, 1990). Rather than being mostly engaged with methods, researchers underline the study problem and use all perspectives available to understand the problem (Rossman & Wilson, 1985). Patton (1990), Morgan (2007), and Tashakkori and Teddlie (2010) transfer its importance for concentrating attention on the research problem in social science research and then using pluralistic methods to conclude knowledge about the problem.

4.4 RESEARCH STRATEGY

Denzin & Lincoln (2011) stated that quantitative, qualitative, and mixed methods techniques are used in any survey strategies in order to provide special orientation for producers that used in the base of research. Strategies have grown over the years due to computer technology has advanced data analysis and ability to analyse complex models and a new steps

had been proposed for impelementing social science research. Table (4-1) next show an overview of the alternatives research strategies.

Table (4-1): Alternative Research Strategies; Source: (Creswell, 2014)

Quantitative	Qualitative	Mixed Method
Design of Experiments Non-experimental Designs, such as Surveys	Narrative Research Phenomenology Grounded Theory Ethnographies Case Study	Convergent Explanatory Sequential Exploratory Sequential Transformative, embedded, or multiphase

4.4.1 Quantitative Inquiry Strategy

In the last of 19th century and throughout the 20th century, the surveys strategies was connected with the quantitative research were those that recall worldview to the postpositivist which including the real experiments and the less rigorous experiments called quasi-experiments (Campbell & Stanley, 1963). An additional experimental design was considered implemented behavioural analysis or individual experiments that applied the experimental treatment for one person or a group of people (Cooper, Heron, & Heward, 2007; Neuman & McCormick, 1995). One kind of non-experimental quantitative research is the negative comparative research which the researcher compares between two or more groups for the real reason that has already happened. Another form of the non-experimental research is the correlated design in which he researchers use the correlational statistic to describe the correlation and measure the degree of correlation between two or more variables or sets of scores (Creswell, 2012).

Among the different quantitative methods, this study conducted the survey method. He advantage of conducting the research by means of survey that it provides numerical illustration of trends, attitudes, or opinions of the participations in the study. It consists of cross-sectional and longitudinal resaerches using surveys or structured interviews for collecting data in order to generalizing from a sample to a population as demonstrated by Fowler in 2009.

4.4.2 Qualitative Inquiry Strategy

Qualitative research considered one of the famous approach during the 1990s until the 21st century. “Qualitative research originally comes from anthropology, sociology, the humanities, and assessment” (Creswell, 2014). Many books have summarized the different kinds, and complete procedures of qualitative inquiry methodss. For example, Clandinin and Connelly (2000) create a view of what narrative researchers do. Moustakas (1994) discussed the philosophical tenets and the procedures of the phenomenological method; Charmaz (2006), Corbin and Strauss (2007), and Strauss and Corbin (1990, 1998) identified the procedures of grounded theory. Fetterman (2010) and Wolcott (2008) encapsulated ethnographic procedures and research strategies of ethnography, and Stake (1995) and Yin (2009, 2012) suggested steps involved in case study research.

The abstracted theory that the research followed in the investigation under study is illustrated subsequently. The quality of education that is perceived by students in universities depends on the availability of facilities in which the learning process takes place. For the achievement of organisational objectives, resources play the crucial role; the proper management of allocation of resources in an educational institution accomplishes the quality access to education. In particular, facilities consisting of buildings that are used for academic and non-academic purpose, equipment, classroom equipment, furniture, instructional materials, audio visual aids, toilet, ICT, library and laboratory materials and others should be given a great attention due to their direct impact on estimated quality conveyed to students.

4.4.3 Mixed Inquiry Strategy

Mixed methods include combining or mixing between qualitative and quantitative research data in a research study. Qualitative data dending on open-ended questions without finding the responses while quantitative data based on closed-ended reactions such as done by means of questionnaires or intellectual tools. The mixed methods used in the research field is conidered new which its basic task in developing it stopped in the late of 1980s, however, its origins goes back further. In 1959, Campbell and Fisk used different approaches to study psychological aspects, the methods they developed are depending on quantitative measures but their work forced others researchers to begin gathering different shapes of data, such as observations and interviews with traditional surveys (Sieber, 1973). The multiple methods are rely on different method which called mixed methods, depending on the concept that all

techniques had erorrs and weaknesses, and the collecting of the data of the quantitative and qualitative methods equalized the weaknesses of both mehods data collected. The Triangulating data sources emerged as a method for convergence across qualitative and quantitative techniques (Jick, 1979). By the early 1990s, mixed methods transferred across the qualitative and quantitative databases systematic convergence, and the cocncept of combining in different kinds of stsudy designs evolved. These types of designs were discussed in widw-range in a main handbook addressing the field in 2003 (Tashakkori & Teddlie, 2010). Further, practices are being widely applied lately in forms of examples of "good" mixed techniques studies and evaluative criteria, and the growth in used of the mixed methods inquiry to other countries and disciplines (Creswell & Plano Clark, 2011).

Through the process of study design by the use of mixed methods, this study will rely on the preliminary sequential design, which is the invert sequence from the explanatory sequential design. In the exploratory sequential perspective, the researcher first starts with a qualitative study stage and explore the opinions of the participants, which was done through the interviews conducted with the logistics and the financial managers in higher education field. The collected data are then analysed, and the analysis results used to build into a second, quantitative stage. The qualitative stage was used to identify the suitable instruments in the follow-up quantitative stage through the production of the directed questionnaire resulting from the conducted interviews to identify the variables (i.e. factors) that need to go into a prioritising quantitative study (Abd Elghany and Elharakany, 2017).

4.5 RESEARCH METHODOLOGY

The research methods include data gathering forms, analysis, and data analysis that researchers suggested in their studies. According to Johnson and Onwuegbuzie (2004), he define the mixed methods research as the category of study where the researcher use both or mixing between the quantitative and qualitative research approaches, techinques, methods, concepts into a single study. Mixed methods research trying to authorized the use of multiple techinques to answering study questions, rather than restricting or restricting researchers‟ choices (i.e., it rejects dogmatism). It is a creative and expansion shape of researches, and not limited shape of researches. It is comprehensive, pluralistic, and interdependent, and it suggests that researchers take an eclectic way to method selection and the thinking about and conduction of research.

As shown in Table (4-2) below, it is useful to look in complete group of possibilities of data gathering and to organize these techniques, for example, by their degree of predetermined nature, their use of closed-ended against open-ended questioning, and their concentration on numeric against nonnumeric data analysis. Researchers gather data on an instrument or test (e.g., a set of questions about attitudes toward self-esteem) or collect information on a behavioural checklist (Creswell, 2014).

Table (4-2): Quantitative, Mixed, Qualitative Methods; Source: (Creswell, 2014)

Quantitative Methods	**Mixed Methods**	**Qualitative Methods**
Pre-determined	Both Predetermined and emerging methods	Emerging methods
Instrument based questions	Both open- and closed-ended questions	Open-ended questions
Performance data, attitude data, observational data, and census data	Multiple forms of data drawing on all possibilities	Interview data, observation data, document data, and individual data
Statistical Analysis	Statistical and text analysis	Text and image analysis
Statistical Interpretation	Across databases interpretation	Themes, patterns, interpretation

On the other side of the sustainability, the data collecting process may include visiting a research sites and monitoring individulas‟ behaviour without predetermined questions or applying an interview which allow the person to speako honestly about a topic, without using any specific questions. The methods selection turns on whether the intent is to specify the kind of information to gather in advance of the research or to allow it to emerge from participants in the project. In addition, the kind of data analysed may be numeric information collected on scales of instruments or text information recording and reporting the voice of the participants (Creswell, 2014). Researchers explain the topics and patterns emerging from the statistical data analysis results. In some kinds of research, both qualitative and quantitative data are gathered, analysed, and interpreted. Instrument data may be supplemented with open-ended observations, or census data may be followed by in-depth exploratory interviews

where the researcher makes inferences across both the quantitative and qualitative databases (Creswell, 2014).

The researcher in this study bases the inquired investigation on the assumption that collecting different kinds of data that could provide clear understanding of the study problem than either qualitative or quantitative data alone. The research starts with qualitative, open-ended interviews to gathered detailed views from participants and then, in a second stage, concentrates on a broad quantitative survey in order to generalize the outputs from the study. The gathering of both open-ended qualitative data proves advantageous and closed-ended quantitative data. Hence, the data gathering instruments were observation, semi-structured interviews and questionnaire. The data will be analysed using the suitable statistical tools, which is the SPSS program to extract the importance weight of each proposed factor in terms of percentages, frequencies, means and grand means as detailed in the next chapter. In brief, the following figure exemplifies the embraced procedures for the research.

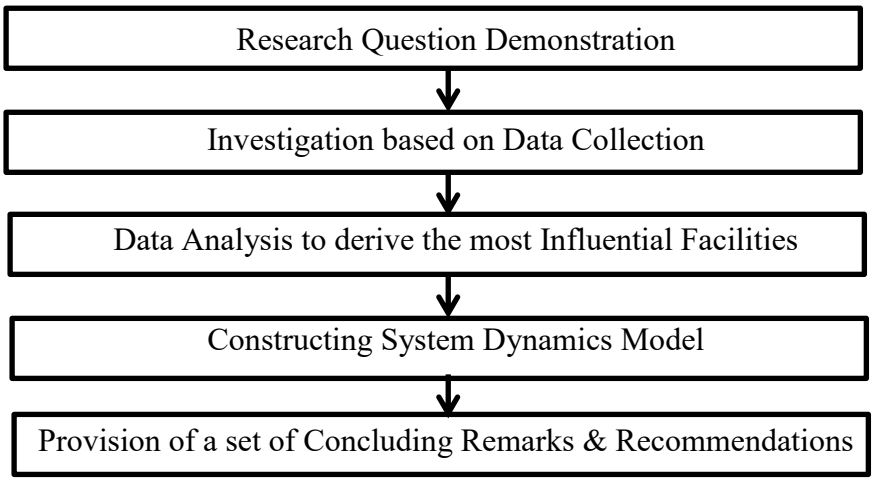


Figure (4-1): Portrayal of Adopted Research Procedures; Source: (The Researcher)

4.5.1 Relevance of System Dynamics

Luna-Reyes and Anderson (2003) in their study define System Dynamics (SD) as a computer-aided method for problems‟ analysing and solving by means of policy design and analysis depending on the hypothesis that the structure of a system of interconnected components generates its behaviour. Forrester (1998) stated that these problems have common aspects in that they are dynamic containing quantities changing in a specific period of time and including the concept of feedback where, item x influences another item y and accordingly y affects x mauby by uesing causes and effects diagram.

Kennedy (2002) asserted that System Dynamics modelling fits to Higher Education issues, which are depending with external forces, corporate governance, planning, resources and budgeting, human resource management, teaching quality, teaching practice, micro worlds, and enrolment demand. Though new research, using other techniques, acknowledges complex connections in modelling higher education issues, nevertheless the methods that they have used are inadequate in that they do not capture feedbacks in their investigation and this may be captured by the utilisation of System Dynamics.

This research adopts the System Dynamics (SD) method to investigate the dynamics of higher education funding and its resulting influence on provided universities‟ facilities to the enrolled students like computer labs, classrooms, health care, sports activities, and extra facilities like premises, transportation, safety and security, and finally the perceived quality of education. The relevance of Dynamic Systems SD remains in its ability to:

- Feedbacks or interactive views modelling as the case of inherent incorporate non-linear relationships in higher educational quality issues;
- Experimenting the behaviour of complexity situations over time;
- Modelling time delays helps in sustaining certain policies on quality as for example; the recruitment of new qualified staff and the investment in new students‟ capacity.

4.5.2 System Dynamics Mixed Methodology

Schwaninger and Groesser (2008) define theory as a “group of organized, explanatory, abstract and coherent set of interconnected data about a reality”. Researchers usually focus their efforts to develop unified theories in order to explain all the observed consistency of social behaviour, social organisation and social change (Merton 1968, quoted in: Schwaninger and Groesser 2008). Hanneman (1988) distinguishes between static and dynamic theories in the following. Static theories concentrate on connected variation and generally take the form “the greater the X, the greater the Y”, whereas the dynamic theories are interested with the process of change as the object to be illustrated.

Moreover, Hanneman (1988) demonstrated three different approaches that can be adopted to develop dynamic theories:

- *Everyday language* that is enriched with commonly accepted scientific writing principles (like the consistent use of terms, quotes, etc.), represents the largely familiar form to express theoretical statements about change processes.

- *Mathematical language*: The use of mathematics to develop a theory has the advantage of including all of the information in a statement that should be made explicitly. Nevertheless, mathematics may turn out to be inadequate once the issue under study is more complicated.
- *Semi-mathematical languages* denote the "languages" that are embodied in software such as Matlab, VENSIM, Stella/iThink or Powersim. They overcome the practical and technical limitations of mathematical language as well as the shortcomings of everyday language (Hanneman, 1988). Semi-mathematical languages express systems of equations that facilitate the use of long, expressive variable names.

Jay W. Forrester developed System Dynamics (SD) in the end of 1950s and start of 1960s through the application of control principles from electric engineering to management and economics (Lane and Oliva, 1998). The best description of System Dynamics is as a methodology that can be used to define the structure of causality driving change process and to elicit the behaviour brought about by complex structures of causality. To achieve this, change processes are modelled as dynamic systems, as a set of equations, regardless whether it stems from the physical, ecological or social domain. Ideally, System Dynamics models are constructed to fulfil definite purposes. They should be demonstrated in appropriate impersonation of the precise feature of reality under investigation. Through the comparison of the model with observations of reality and its enhancement, a useful and empirically grounded description of the feature of reality steadily appears. The main building blocks of a System Dynamics model are called *stocks* that vary over time by in- and out*flows*. The dynamics of a system is caused from the interactions between its stocks and flows over time, specifically from circles of causality called *feedback-loops*.

As established earlier in section 4.4.2, Grounded Theory contributes to the research design of this research project. Grounded Theory can be comprehended as epistemically related to System Dynamics for the reason that Systems Thinking makes use of the concept "system" to order thinking about the world. Setting "some constructed abstract wholes (often called „systems models") against the perceived real world in order to learn about it" (Checkland and Scholes 1998). In addition to the persistence of the concept of „theoretical sampling" of data or interviewees then the analysis of interviews and the iterative research associated.

The start of Grounded Theory can be found in the book publication entitled *The discovery of grounded theory* by Glaser and Strauss (1967). Since that, a large group of social science research was established and this group adopting this methodology. Strübing (2004) define the Grounded Theory as a „conceptually condensed, methodologically justified and internally consistent collection of proposals", which have verified usefulness for the production of rich theories within the context of social sciences. Grounded Theory broadly depends on an repeated research process concentrating on the repeated comparison of theoretical concepts with empirical data (Oxford Dictionary of Sociology 1998, Grounded Theory).

Causal Loop Diagrams (CLDs) in System Dynamics represent the graphical description of the feedback structure of systems and particularly, they are used to portray the structure of causality between variables rather than the structure of correlation between variables. A causal loop diagram is composed of variables, which are connected with an arrow in accordance to the direction of causality; i.e. the combination of reinforcing and balancing feedback loops besides the addition of delay, any system can be sketched in such a qualitative approach. Nevertheless, they do not provide too much precision, and they cannot be used to analyse the effects of multiple causalities. On the other hand, quantitative simulation permits the interpretations of how structures of causality yield a system"s behaviour. In System Dynamics, the stock-and-flow-diagrams are well established to visually give a representation of the fundamental structure of System Dynamics models. Computer simulation software (such as VENSIM & POWERSIM) is used to construct the stock-and-flow diagrams that require specification with the equations and parameters.

Furthermore, System Dynamics simulation models are best characterized as empirically grounded, theoretical constructs; they excel the simple division between "qualitative" and "quantitative" approaches. In the development of any model, numerical data obtained from surveys can be integrated with insights produced from "qualitative" research. Any source of information that is relied upon non-numerical empirical research methods like interview and observations can provide a whole range of contributions to computer assisted theory building with System Dynamics in order to help in the comprehension of the model context and the conceptualization of the model structure. Finally, System Dynamics has been developed as a method for ‚*group model building'* together with practitioners (Vennix 1996; Andersen and Richardson 1997a & b).

4.6 EDUCATION SYSTEM AND SYSTEM DYNAMICS

Sterman (2000) considers Education as a pipeline starting from kindergarten through elementary, secondary, high school, higher education through college until postgraduates‟ studies. At the highest level of recursion, Education interacts with other systems such as culture, economics, politics, and society At a lower level, an individual university is influenced by factors such as the surrounding environment, teachers, school principals, course design, technology and funds.. Education budgeting is directly controlled governmental resource allocation decisions.

The educational system cannot be changed overnight. The economic influence of policy changes has built-in delays that might be in the order of a decade and some policy changes are irreversible. Good university faculties with experienced and professional staff create better learning environments which will normally result in better qualified students. A unprofessional mathematics‟ teacher can have a lasting impact on students‟ interests and skills in mathematics. The educational system consists of many feedback loops. An example is the causal relations between good professors and the provision of good facilities contribute to better graduates who, in turn, will strengthen their universities‟ brands enabling them to attract better applicants, better professors, more financial resources, and more research opportunities. The impacts of change are not proportional. For example, a simple policy change in the retirement age at universities brings about an approximately twenty percent decline in faculty opening positions (Larson and Gomez Diaz, 2012). Education is a non-linear system where the mixing of feedback circles, delays, and nonlinearity lead to unexpected results. Increasing university funding may not translate to increased productivity (Hur et al., 2015; Ghaffarzadegan et al., 2014). Cultural, social, and psychological backgrounds play an important role in the decisions related to education process (Xue and Larson, 2015). Bad, unproven policy changes can often have only small influences and resources can be wasted, thus making it necessary to improve the decision making of university administrators.

A system can be dined as a set of interdependent components contributing together to achieve a goal. A bicycle can be considered as a good example of system. It is composed of frame, brake, chain and gearing, saddle, suspension, wheel and tires. These parts could not become a transportation tool by their own; they are connected in a specific way. Balance is easier maintained when the bike is moving so its stability is dynamical rather than stationary one.

Richmond (2004) demonstrated that thinking decomposes into two processes; constructing a mental model of the situation and then its simulation. There are several types of mental models used thinking. Richmond suggests the following list.

1. Verbal models, in which the words and narrative stories are used to describe the world. It is considered the most flexible due to a language‟s richness;

2. Conceptual models, in which a visual map is used to represent the relationship between concepts like class diagrams, data model, and causal loop diagrams;

3. Spread Sheet models or table/matrix models such as used by Excel;

4. Operational models in which the dynamics and behaviour of the system is illustrated like state diagram, system dynamics/stock-flow diagram, workflow, and petri net.

5. Geometric models in which a simple graph is used to explain behaviour over time or relations between variables;

6. Mathematical models which use some form of algebraic or differential equations;

7. Computer models executed by a program.

System modelling or simulation is used to represent a reality picture via an abstraction, and to communicate the important system‟s aspects. Quite a few scenarios can be simulated to verify the usefulness of the model. The simulation is crucial for the decision maker to understand the dynamics of a system. The complexity along with the interconnectedness from every part of the system can be sensed by looking at the final model. In the System Dynamics methodology, these components are modelled as stock variables, whose values are evaluated at a moment in time. These stock levels are changed by inflows and outflows which are determined either by parameters from external world or by their internal feedback loops (reinforcing/positive or balancing/negative). The above models are interrelated in various degrees.

Forrester (1971) suggests three behaviours for social systems. The first separates cause and effect in space and time. Policies tend to treat the symptoms rather than the causes so that the result of a policy can be completely different than was initially intended. This can be a result

of both system delays (due to stocks) and system interconnectedness (due to feedback cycles). Cause-effect relationship actually might occur in both directions creating virtual feedback loops. The second is concerned with the identification of leverage points. This can be difficult in a social system which can have unexpected strong leverage points If a policy interacts with a weak leverage point of the system, then it will not change the system behaviour. The third behaviour depends on the fact that a social system is usually in conflict between short-term and long-term results. A successful short-term solution usually corrodes success in the long term. This view categorises social systems as multi-loop nonlinear feedback systems rather than a simple short time linear cause effect. Real-world complex systems are always changing. Modellers attempt to develop models that predict future state of a system, yet no long run predictions may exist for complex system. It is better to construct a system structure using leverage points behaving well and withstanding external uncertain shocks in the future (Meadows, 1999).

System Dynamics can be used to model the behaviour of complicated systems using feedback cycles. Its methodology is based on system thinking; which is an influential metaphor for building models of systems at a point of time and examining the change to that state over a specific period. It attributes the causes of system behaviour from within the system not from forces external to the system. Modelling aims at gaining insight about behaviour and not prediction. Moreover, it can speed up communications and is truly understandable as it doesn‟t explicitly show the mathematical equations. Accordingly, modelling activity can engage more people and be more conversation oriented.

Higher education is a multifaceted complicated system in which any decision influences other parts of system in an indirect or direct way. Decisions related to resource management and funding allocation at re important variables in the system. These variables do not only affect the internal performance of the university reflected, but also indirectly change the quality perceived by the students accordingly student satisfaction. A systematic approach is needed to consider these interconnected relationships and the impacts of the different management decisions.

4.7 SUMMARY

This chapter outlines the theoretical foundation of the research, defines the adopted philosophy, justifies the triangulation approach embraced and demonstrates the mixed

research pragmatic method applied. The flow of research methodology in this project began with data gathering and analysis leading to the need of the proposed model development, multidisciplinary literature review of related research and previous studies, brainstorming sessions, expert field evaluation, then presented the model design; its causal loops & stock-and-flow diagrams, and ended-up with model implementation and testing.

CHAPTER FIVE

DATA COLLECTION & STATISTICAL ANALYSIS

5.1 INTRODUCTION

Since this study purpose is to investigation of the correlation between facilities management and universities quality of education thus, the data sourcings are anagers of the services and logistics‟ heads. For the reason that they are capable of identifying the most effective facilities that should be vitally prioritised in fund when allocating budget in universities for sustaining and enhancing the quality of education conveyed to the students. This chapter will introduce the outputs of the conducted survey and discuss the outcome of the analysis after giving an overview on the higher education background in Egypt.

5.2 EGYPTIAN HIGHER EDUCATION CONTEXT

In 1923, Egypt agreed on a constitution which, amongst many other issues, looked at Education in Europe, it was stated that elementary education is obligatory for every Egyptian child. Later in 1948, Egypt signed the Universal Declaration of Human Rights, supporting all the human rights it includes, in which the right for everyone to education is clearly indicated. In turn, a unified mandatory elementary education system was established. Education is now considered as national security issue by the Egyptian political leadership. Accordingly, special attention has been given to the educational policy through numerous development programmes over the past few years. In 1981, the constitution included Education Law No. 139 which stated that the government was obliged to increase the scope of education in Egypt and in 1999; the law was extended to include compulsory attendance for nine years, where six of those nine years should represent the primary education. (Richards, 1992)

The foremost benefit of the Egyptian education system is that its structure (age and level) is simple in comparison with other complicated educational systems like the French one. The next items show the different education‟s levels (UNDP, 2003):

- Basic schooling: primary level which consists of six years and preparatory level which consists of three years preparatory, which represent a right for every Egyptian child. General secondary schools or technical secondary schools could be joined after grade nine.

- General secondary schooling: beginning from grade ten and lasting for three years that is aimed for the students‟ preparation for practical life and higher education as well. The stage consists of three years. Graduates from secondary education stage can easily apply for higher education level relying on their results of Thanaweya Amma (the secondary school leaving exam).

- Technical secondary schools: divide to agricultural, industrial, and commercial and takes place at two levels. The first level encompasses a three-year system to prepare a group of technicians and the second level a five-year system to prepare senior technicians. Graduates with appropriate grades from both tracks are allowed to admit for higher education in accordance.

- University and higher education: is implemented in universities or higher specialised institutes, in which the study duration for middle technical institutes is ranging from two years in to four, and for university colleges and higher institutes ranging from five, or even six years. Postgraduates‟ studies including masters and doctorate of philosophy degrees should take at least two years and three years to be awarded respectively.

- The Azhar schools deal with religious education and exist all over the country. They follow the same study path and their shares are quite large in primary level then decrease at higher level. The foundation of Al-Azhar mosque by the Fatimids in 988 AD is recognised as the beginning of higher education in Egypt. It is considered to be as the world‟s oldest university, named Jami'ah equivalent to "university" in Arabic. , It offers academic degrees and has individual faculties for Arabic grammar, madrasah and theological seminary, early Islamic philosophy and logic in Islamic philosophy, Islamic astronomy, Islamic law and jurisprudence (http://en.wikipedia.org/wiki/Al-Azhar_University).

- Mohamed Ali considered one the founders of modern Egypt. Under his supervision, the first elementary public schools and higher education schools began to offer a new curriculum, which included administration, engineering and accountancy to meet emerging needs. Mohamed Ali‟s successors later had begun at prior levels of education, by recently recognised American, British, and French missionary foreign

schools with oriented curricula to their own countries. This policy aimed to westernise the Egyptian system and began to show beneficial effects in the second half of the nineteenth century. These alterations also had an effect on the expansion of the educational sector (Cochran, 1986). In 1908, with the help of donations from the great and the good. The first national university (Cairo University) was established. This offered courses on economics, history, literature, and philosophy (Richards, 1992). The university was renamed Fouad I University in 1940 after the son of Khedive Abass. The Minister of Public Education, Saad Zaghlul Pasha, also founded a number of agricultural schools between 1911 and 1921 became higher schools (Cochran, 1986). In 1919, a group of Americans who were concerned to spread American culture in the Middle East established the American University in Cairo as an English language university.

The Egyptian government made a decision to nationalise all foreign schools in 1934 and instructed that students must learn Arabic by Law 40. The universities at Alexandria and Ain Shams were founded in 1942 and 1950. After the revolution in 1952, these improvements continued to meet the growing flow of secondary education graduates. This socialist centralised framework was clearly witnessed in the significant growth of the enrolment in the education system. Egypt (even though it was suffering economically, initiated international scholarships to thousands of students from other Islamic states which in return gave Egypt a role in regional development. After 1957, the number of Egyptian universities was increased from five public universities. Universities were opened throughout the country such as Assuit, Aswan, Qena and Sohag University, split to form the South Valley University then Sohag separated autonomously in 2006. The university branching process is obviously horizontal in direction in order to make the university education accessible to more students all over the country and satisfying the mounting demand for higher education. Nevertheless, despite these efforts, the government did not succeed in achieving the quality necessitated for higher education due to a number of factors such as not enough employees and poor facilities. The low wages offered, meant that often professors had to teach in several universities at the same time (World Bank, 2011).

The history of the Supreme Council of Universities (SCU) is dated to the Royal Decree 496 (1950) and the Presidential Decree 508 (1854) (http://www.frcu.eg/www.supreme.html). Since 1992 until now, the door was opened for more private universities to emerge as new

providers appeared (there were four opened in 1996 alone). Private education in Egypt is mostly profitable and self-funding, where its fundamental income source of income comes the tuition fees that students pay. Furthermore, the private sector was exempted from any domestic taxes till 2008 consequently; this helped in increasing their profits. On the other hand, higher education in Egypt has been facing lessening governmental budgets and growing dependence on the private sector (Richards, 1992). In 1994, the governmental decreased the financing of higher education by 15%. Some public universities have presented high quality foreign language programmes in order to recompense such saving, for which nominal tuition fees and other relevant fees are charged (World Bank, 2002).

In the period 2007-2012, the budget of the Ministry of Higher Education MoHE was one billion Egyptian Pounds. This was called the Continuous Improvement and Qualifying for Accreditation Project (CIQAP). For the reason of the enhancement of the undergraduate/graduate educational process, the improvement of community service activities and research, and the sustainability of their internal Quality Assurance systems. The management of universities/institutes is aware that there exist specific standards for facilities to meet the requirements of accreditation bodies. Standards include laboratories and libraries, space, lighting, ventilation, working hours. Egyptian universities should also enhance the quality of higher education through facilitating the networking of, better and faster access to information, e-learning and distance learning, digital libraries, and management information systems. To sum up that is why this research targeted the investigation of service facilities in Egyptian higher education.

Twenty public universities and twenty-three private universities were surveyed. The major private source was the Arab Academy which is the host University of the researcher and two public universities (Ain Shams and Cairo) have nearing one million students between them, so the survey can be regarded as being representative of Egyptian Higher education.

5.3 SAMPLE DESCRIPTION

The researcher was motivated to undertake a qualitative study interviewing in-depth several decision-makers of budget allocation in twenty-three private universities and twenty public universities as shown in the subsequent tables.

Table (5-1.a): Public Universities Sample; Source: (The Researcher)

Serial Number	Name of the University (PUBLIC UNIVERSITIES)
1	Cairo University
2	Ain Shams University
3	Alexandria University
4	Mansoura University
5	Assiut University
6	Helwan University
7	Zagazig University
8	University of Al-Azhar
9	Tanta University
10	University of Shibin El Kom
11	Al Minya University
12	Banha University
13	Suez Canal University
14	Sohag University
15	Kafr El Sheikh University
16	Beni Suef University
17	Port Said University
18	Al Fayoum University
19	South Valley University
20	Damanhour University

Table (5-2.a): Private Universities Sample; Source: (The Researcher)

Serial Number	Name of the University (PRIVATE UNIVERSITIES)
1	American University of Cairo
2	Arab Academy for Science and Technology and Maritime Transport
3	German University in Cairo
4	October 6 University
5	Modern Sciences and Arts University
6	British University in Egypt
7	Misr International University
8	Misr University for Science and Technology
9	Delta University for Science and Technology
10	Pharos University in Alexandria
11	Nile University
12	Al-Ahram Canadian University
13	Sadat Academy for Management Sciences
14	Sinai University
15	International Academy for Media Sciences
16	Future University in Egypt
17	El Shorouk Academy
18	Thebes Academy
19	Canadian International College
20	Egypt-Japan University of Science and Technology
21	Egyptian Russian University
22	Future Academy
23	Modern Academy in Maadi

5.3.1 Methods of Data Collection

Surveys allow the researcher to came-up data regarding to practices, situations or opinions at specific time by means of interviews and questionnaires. The use of surveys permits the examination of multi-variables, and at the same time data can be gathered about real world environments. Quantitative analytical techniques are then employed to produce implications from the conducted interviews and the related perceived data.

The interviews conducted on a specific time schedule, arranged according to the interviewee and interviewer agreement. The researcher initiated a discussion about their adopted policy in budget distribution and the various vital service facilities that should be funded from their perspective to better enhance the student experience in their universities and ultimately the perceived quality of education. There were several advantages from conducting these interviews as the researcher was enriched with in-depth data that was flexible, quick and inexpensive to build upon the questionnaire design structure. Furthermore, it gave the researcher a chance to observe various reactions of managers in public and private universities in open and free discussions with each other. The researcher exerted a great effort in playing the role of a moderator or facilitator to keep the discussion on track and focused in order to obtain all the relevant information in an effective way. However, she never became an integral part of the discussions.

5.3.2 Sampling Techniques

The most suitable sampling method in the probability sample for this research is stratified random sampling. Stratified random sampling is a modification of random sampling in which the population grouped into two or more suitable and significant strata based on one or a number of attributes. Actually, the sample frame divided into a number of subsets. A simple random sample then taken from each of the strata.

Sample size selection within this consistin of the followings steps:

1. The confidence needed that is, the level of conformity that the aspects of the gathered data will represent the characteristics of the whole population;
2. Error‟ margin that can be accepted, that is, the accuracy require for any estimates came from the sample; and
3. Analyses types that will be performed.

The researcher chooses 95 per cent level of certainty (margin of error 5 per cent). The surveys (which contained a covering letter and the questionnaire) were mailed to managers and decision makers in charge of funding allocation and logistics and materials supervision. It was assumed that these managers were able to give accurate replies to the questions. 43 universities replied with 328 completed questionnaires which equates to a response rate of 54%. According to Kline (2005) and Palaima and Auruskeviciene (2007), this survey size is very adequate.

5.4 DATA ANALYSIS

The data gathered that is analysed for interpretation will be discussed thoroughly in the following sections. SPSS version 20 was used for the analysis and according to standard practice, the responses were coded according to the Likert scale (1-5) and the variables were reversed scored. Before that, there were two stages:

Stage One: Great care was taken to ensure that the translation of the questionnaire from English to Arabic was correct. .According to Brislin (1980), Hui and Triandias (1985), Newmark (1988), and El-Kot (2001), a suitable procedure is back translation. Professional translators from AAST and native English speakers were used and any major discrepancies were noted and corrected (Kivimaki et al., 1997; El-Kot, 2001).

Stage Two:

The questionnaire was tested to see if the questions were clearly stated and appropriate. Experts in questionnaire design looked the clarity and five faculty members from AAST were selected to ensure that the questions reflected the domains under scrutiny and whether they were applicable to the targeted population.

The final questionnaire (see Appendix A & B), was then deemed to measure the concepts adequately thus providing assurance of content and face validity.

5.4.1 Correlation Results

This section is dedicated for the illustration of the performed correlation analysis that is performed to quantify the association between two continuous variables between an independent variable representing the questioned service facility factor and a dependent variable, which is the perceived quality of education. The sample correlation coefficient, Pearson correlation coefficient denoted (r) is estimated, which is ranged between -1 and +1 and quantifies the direction via the sign and the strength via the magnitude of the linear association between the two variables. Positive notation suggests strong association while negative notation indicates weak association (Refer to the Correlation Coefficients Analysis Table placed in the Appendix C). Among the different investigated service facilities‟ factors affecting the perceived quality of education, the subsequent highlighted factors were the highly correlated ones. X7 Buildings‟ Condition encompassing university principal‟s office

(access to computer, telephone, guest chairs, shelves, shutter), staff rooms (chairs, tables and shelves), classrooms (floors, walls, and roofs, shutter, student seats, file cabinet, whiteboards, space) gave r=0.745 and P<0.1. X13 Availability of Sanitary Materials such as provision of first aid in case of accidents resulted in r=0.748 and P<0.1. X14 Computer Service for staff members, administrators and students produced r=0.773 and P<0.1. X15 Provision of Buses for Staff & Students Transportation yielded r=0.725 and P<0.1. X16 generated r=0.571 and P<0.1. X20 Presence of Security Personnel and Cameras to grant Safety with front desk monitoring & Control loitering gave r=0.774 and P<0.1. X24 Sport Resources such as playgrounds, changing rooms, bathrooms, etc. produced r=0.862 and P<0.1. X25 Follow Repairing System (Electrical, Energy, and Sustainable Practices) generated r=0.835 and P<0.1. X27 Ease of Access to Wide Range of Course Books/ Core Texts and Research Hive resulted in r=0.897 and P<0.1. X29 Laboratory Equipment with adequacy of ICT aids‟ application yielded r=0.844, P<0.1 and X30 Recruitment of Qualified Staff for Every Facility gave r=0.810 and P<0.1. The following tables reveal the results of the correlation sequentially in accordance of sample size and its characteristics and frequencies.

Table (5-3): Sample Frequency in Accordance to Gender Characteristic; Source: (The Researcher)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	241	73.5	73.5	73.5
	Female	87	26.5	26.5	100.0
	Total	328	100.0	100.0	

It was found from table (5-3) that 241 (73.5%) of the respondents were males, while 87 (26.5%) were females.

Table (5-4): Sample Frequency in Accordance to Age Characteristic; Source: (The Researcher)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	25 years less than 34 years	79	24.1	24.1	24.1
	34 years less than 44 years	102	31.1	31.1	55.2
	44years less than 54 years	88	26.8	26.8	82.0
	54 years and more	59	18.0	18.0	100.0
	Total	328	100.0	100.0	

It was found from table (5-4) that 102 (31.1%) were aged in the range of 34 years old and less than 44 years and 88 (26.8%) were aged in the range of 44 years old to less than 54 years. Then 79 (24.1%) were aged in the range of 25 years old to less than 34 years, and only 59 (18%) were aged in the range of 54 and above. Age ranges reflect the level of expertise of the participants.

Table (5-5): Sample Frequency in Accordance to Educational Degree Characteristic; Source: (The Researcher)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	school graduate	59	18.0	18.0	18.0
	college graduate	95	29.0	29.0	47.0
	post graduate degree	174	53.0	53.0	100.0
	Total	328	100.0	100.0	

It was found from table (5-5) that 174 (53%) of respondents held a postgraduate degree, 95 (29%) of respondents held bachelor university degree, and only 59 (18%) of respondents were school graduates.

Table (5-6): Sample Frequency in Accordance to Management Role in the University Characteristic; Source: (The Researcher)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	upper management	59	18.0	18.0	18.0
	middle management	86	26.2	26.2	44.2
	junior management	174	53.0	53.0	97.3
	Consultant	9	2.7	2.7	100.0
	Total	328	100.0	100.0	

It was found from table (5-6) that 174 (53%) of respondents were junior management, 86 (26.2%) of respondents were middle management, and only 59 (18%) of respondents were upper management.

Table (5-7): Sample Frequency in Accordance to Work Experience Characteristic; Source: (The Researcher)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	less than 5 years	79	24.1	24.1	24.1
	5 years less than 10 years	102	31.1	31.1	55.2
	10 years less than 20 years	88	26.8	26.8	82.0
	20 years and more	59	18.0	18.0	100.0
	Total	328	100.0	100.0	

It was found from table (5-7) that 102 (31.1%) of the respondents had a work experience in between 5 and less than 10 years. 88 (26.8%) of the respondents had a work experience in between 10 and less than 20 years. 79 (24.1%) of the respondents had a work experience less than 5 years, and only 59 (18%) of respondents had a work experience of 20 years and more.

Table (5-8): Sample Frequency in Accordance to Earned Income Characteristic; Source: (The Researcher)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	less than 5000 L.E	18	5.5	5.5	5.5
	5000 L.E - less than 10000L.E	109	33.2	33.2	38.7
	10000 L.E - less than 20000L.E	109	33.2	33.2	72.0
	over 20000L.E	45	13.7	13.7	85.7
	would rather not to say	47	14.3	14.3	100.0
	Total	328	100.0	100.0	

It was found from table (5-8) that 109 (33.2%) of the respondents had an earned income in between 5000 L.E and less than 10000L.E. Also, 109 (33.2%) of the respondents had an earned income in between 10000 L.E and less than 20000L.E. 47(14.3%) of the respondents would rather not to say, 45 (13.7%) of the respondents had an earned income over 20000L.E and only 18 (5.5%) of respondents had an earned income of less than 5000 L.E.

Table (5-9): Sample Frequency in Accordance to University Type; Source: (The Researcher)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Public	143	43.6	43.6	43.6
	Private	185	56.4	56.4	100.0
	Total	328	100.0	100.0	

It was found from table (5-9) that 143 (43.6%) of respondents were from public universities and 185 (56.4%) of respondents were from private universities.

5.4.2 Developing the Regression Equation

Regression analysis is a technique to assess the connection between two or more variables. The outcome variable is called the response or dependent variable and the factors or

confounders are called the predictors, or explanatory or independent variables. The first problem was to determine the dependant variables. Using the researcher‟s experience of working since college graduation in a Higher Education establishment and with the knowledge transfer between the researcher and her colleagues, the researcher constructed the following diagram in Figure (5-1) below, in reference to previous scanned literature review, linking what she perceived as the important variables relating facilities to quality.

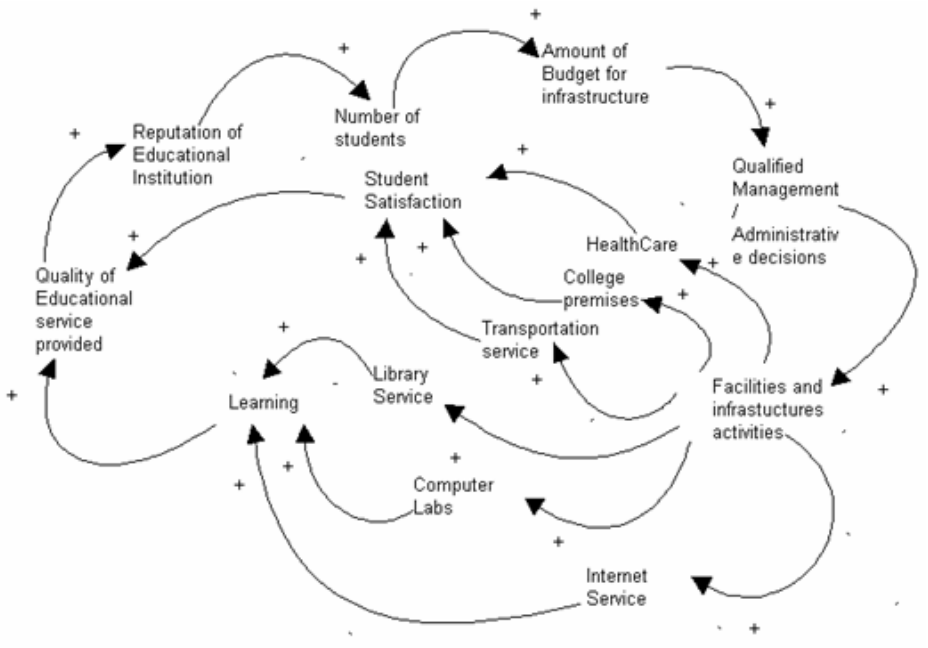


Figure (5-1): General Proposed Model; Source: (The Researcher)

This diagram was then shown to the heads of various facility providers and quality mangers at several universities. The arrows and plus/minus signs were explained and the interviewees were asked to comment on the links and if needed add extra links. The result was a refined model shown in figure (5-2).

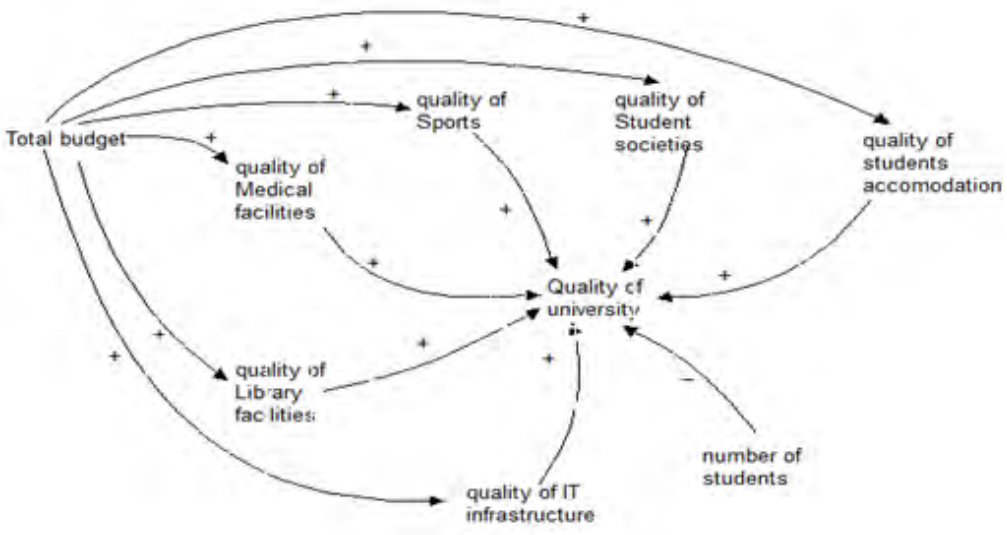


Figure (5-2): General Revised Model; Source: (The Researcher)

Then a revised model were developed based on the the interviewees, and given an opportunity to do more revisions. The final agreed causal model is presented in figure (5-3).

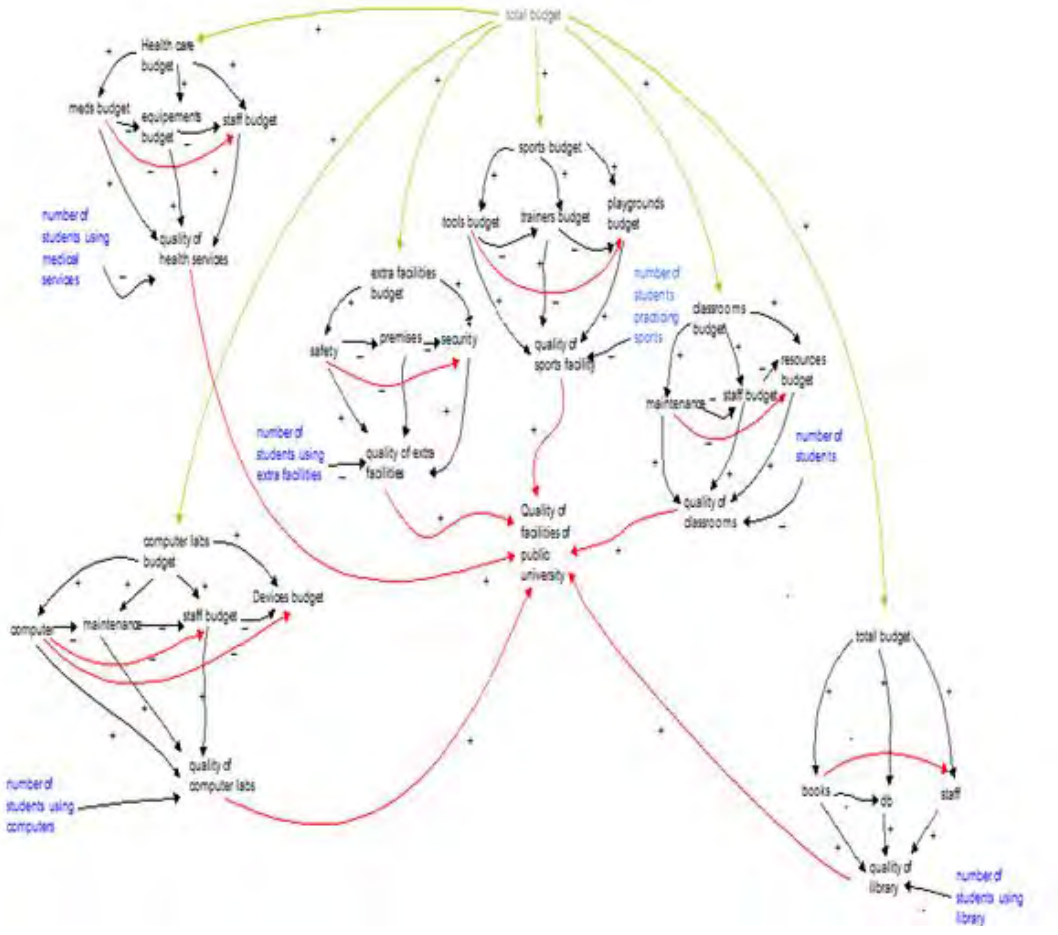


Figure (5-3): General Refined Model; Source: (The Researcher)

Using the above causal model as a guide, the following regression analysis was set up based upon the relationship between the dependent variable, which is the perceived quality of education, and the confounders, which are the thirty questioned service facility factors as presented in figure (5-4) below. The dependent variable is denoted "fa" and the independent variables are denoted by "x".

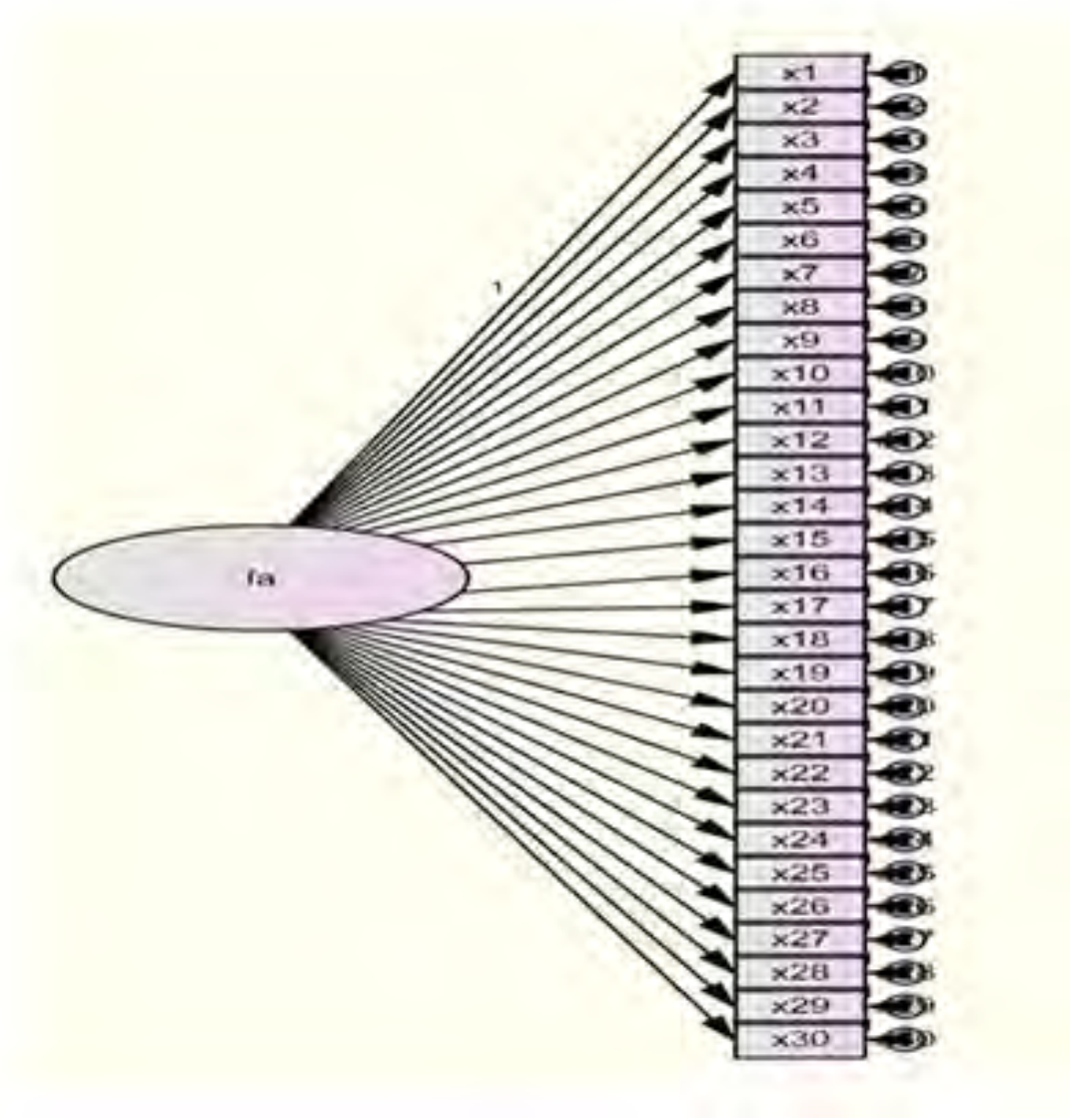


Figure (5-4): Model of the Relationship between the Dependent Variable and the Confounders; Source: (The Researcher)

The statistical software AMOS 20 was then applied to choose the maximum likelihood estimation method. The fit measures show that the introduced model is within the acceptable level for social science (see table (5-10) below) as Chi-square statistic (CMIN) 295.656 is significant with degrees of freedom (DF = 107, n =328).

Wheaton et al. (1977) recommended that the researcher also should compute a relative chi-square divided by degrees of freedom, which resulted in (2.763) as indicated in table (5-10). Carmines and McIver (1981) and Wheaton et al. (1977) suggested a ratio of 3 to 1 are sign of an acceptable fit between the hypothetical model and the sample data.

Table (5-10): Chi-square CMIN; Source: (The Researcher)

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	46	295.656	107	.000	2.763
Saturated model	153	.000	0		
Independence model	17	5915.394	136	.000	43.496

Steiger and Lind (1980) suggested the impact of model complexity could be compensating by dividing by the value of the degrees of freedom for testing the model. The square root of the resulting ratio represents the population Root Mean Square Error of Approximation as shown in table (5-11) below, which is called RMS by Steiger and Lind, and RMSEA by Browne and Cudeck (1993). In general if the RMSEA, a value of about 0.08 or less would point-out a reasonable error of approximation and would not want to employ a model with a RMSEA greater than 0.1 (Browne and Cudeck, 1993). In the researcher model, the value of REMSA was 0.073, which indicates a good fit.

Table (5-11): Root Mean Square Error of Approximation RMSEA; Source: (The Researcher)

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.073	.064	.083	.000
Independence model	.360	.353	.368	.000

Furthermore, other indices such as NFI (.950), CFI (.967), GFI (.904), and AGFI (.862) model are all within the acceptable level for social science as interpreted in table (5-12) and (5-13).

The Bentler and Bonett (1980) Normed Fit Index (NFI), the Comparative Fit Index (CFI) The GFI (Goodness-of-Fit Index) was devised by Jöreskog and Sörbom (1984) for ML and ULS estimation, and generalized to other estimation criteria by Tanaka and Huba(1985). The AGFI (adjusted goodness-of-fit index) takes into account the degrees of freedom available for testing the model, models with overall fit indices of more than 0.9 represents a good fit.

Table (5-12): Root Mean Residual RMR, Goodness of Fit Index GFI; Source: (The Researcher)

Model	RMR	GFI	AGFI	PGFI
Default model	.052	.904	.862	.632
Saturated model	.000	1.000		
Independence model	.855	.130	.021	.115

Table (5-13): Baseline Comparisons; Source: (The Researcher)

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.950	.936	.968	.959	.967
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

5.4.3 Results of the Regression

91.1 per cent of variation of Bookstore for providing Textbooks, Reference Books, Dictionaries, & Teaching Guides and Manuals, and 88.3 per cent of variation of Ease of Access to Wide Range of Course Books/ Core Texts and Research Hive (Online Resources). In addition to 87.9 per cent of variation of Recruitment of Qualified Staff weigh up library services‟ facilities for quality of education. These results imply that library services are considered the most significant service facility factor for the quality of education. The proceeding figure (5-5) gives a simple exemplification of the library services facilities factor.

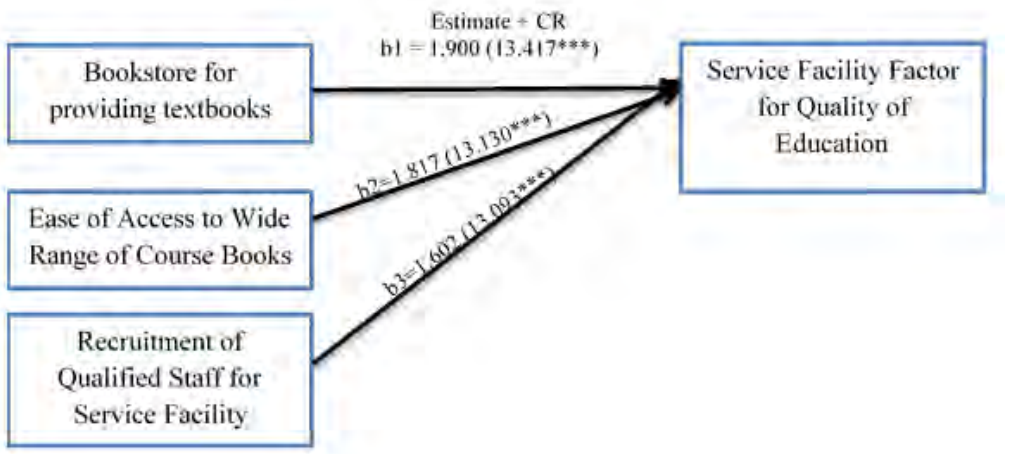


Figure (5-5): Illustration of Library Services Facility Factor; Source: (The Researcher)

87.6 per cent of variation of Laboratory Equipment with adequacy of ICT aids‟ application weighs up for service facilities for quality of education. These results imply that computer labs are considered to be the second significance service facility factor for the quality of education. 86.8 per cent of variation of provision of Computer Service for staff members, administrators and students and 86.4 per cent of variation of Buildings‟ Conditions encompassing university principal‟s office (telephone, guest chairs, shelves, shutter), staff rooms (chairs, tables and shelves), classrooms (floors, walls, and roofs, shutter, student seats, file cabinet, whiteboards, space) reflect service facility factor for quality of education. These results imply that classrooms are considered to be the third significance service facility factor for the quality of education.

86.1 per cent of variation of Sport resources such as playgrounds, changing rooms, and bathrooms indicate service facilities for quality of education. This result implies that sport activities are considered to be the fourth significance service facility factor for the quality of education.

85.8 per cent of variation of Availability of Sanitary Materials, such as provision of first aid in case of accidents, signifies service facilities of quality of education. This result implies that healthcare services are considered to be the fifth significance service facility factor for the quality of education and so on. Table (5-14) reveals the degree of significance of each service facility factor that contributes to the perceived quality of education.

Table (5-14.a): Significance of Service Facility Factors to Perceived Quality of Education; Source: (The Researcher)

S	Code	Statements	Standardized Regression Weights	Estimate	Standard Error (SE)	Critical Ratio (CR)	Significance
1	X28	Bookstore for providing Text books, Reference books, and Dictionaries, and also Teaching guides and manuals	.911	1.900	0.142	13.417	0.0001
2	X27	Ease of Access to Wide Range of Course Books/ Core Texts and Research Hive (taking into consideration online resources)	.883	1.817	0.138	13.130	0.0001
3	X30	Recruitment of Qualified Staff for Every Facility	.879	1.602	0.122	13.093	0.0001

Table (5-14.b): Significance of Service Facility Factors to Perceived Quality of Education; Source: (The Researcher) Continued

4	X29	Laboratory equipment with adequacy of ICT aids‟ application	.876	1.714	0.131	13.057	0.0001
5	X14	Computer Service for staff members, administrators and students	.868	1.582	0.122	12.976	0.0001
6	X7	Attractiveness of the university compound and fencing in terms of buildings‟ condition encompassing university principal‟s office (access to computer, telephone, guest chairs, shelves, shutter), staff rooms (chairs, tables and shelves)	.864	1.636	0.126	12.937	0.0001
7	X24	Sport resources such as playgrounds, changing rooms, bathrooms, etc	0.861	1.547	0.120	12.906	0.0001
8	X13	Provision of Health Care services (sanitary materials such as provision of first aid in case of accidents, availability of medication)	0.858	1.492	0.116	12.868	0.0001
9	X20	Security (Presence of Security Personnel and Cameras to grant Safety with front desk monitoring & Control loitering)	0.854	1.619	0.126	12.831	0.0001
10	X25	Follow Repairing System (Electrical, Energy, Sustainable Practices)	0.853	1.720	0.134	12.816	0.0001
11	X15	Provision of Buses for Staff & Students Transportation	0.847	1.564	0.123	12.751	0.0001
12	X23	Stationary materials such as: papers, notebooks, chart and graph papers, pens, pencils and others, besides Teaching aids such as white boards, markers, etc.	0.834	1.492	0.118	12.612	0.0001
13	X26	Accessibility to Computer Clusters	0.833	1.796	0.143	12.600	0.0001
14	X22	Provision of Comfortable Seating with Low Level Tables, Well-Organized Book Shelves, Proximity of Books & Convenience of Library Environment (Lighting, Temperature, Power Sockets & Wireless Connection for the Access of Online Resources Service)	0.829	1.468	0.117	12.562	0.0001

Table (5-14.c): Significance of Service Facility Factors to Perceived Quality of Education; Source: (The Researcher) Continued

15	X12	Classrooms Convenience (floors, walls, and roofs, shutter, student seats, file cabinet, whiteboards, space)	0.827	1.422	0.113	12.535	0.0001
16	X4	Music instruments for personal and social development	0.815	1.662	0.134	12.414	0.0001
17	X3	Coffee Cart near the library entrance/ Cafeteria/ Dining Areas	0.789	1.504	0.124	12.115	0.0001
18	X11	Efficient overhead projector and LCD Liquid Crystal Display for educational purposes	0.765	1.146	0.097	11.840	0.0001
19	X10	Accessibility to functional photocopy machines	0.757	1.153	0.098	11.754	0.0001
20	X6	Cleanliness (Waste Cans for Trash, Garbage & Recycling)	0.755	1.410	0.120	11.730	0.0001
21	X8	Disability Service/ Accessibility / Handicapped Improvements	0.706	1.222	0.110	11.149	0.0001
22	X9	Presence of printing service	0.702	1.187	0.107	11.092	0.0001
23	X5	Accessibility of portable water, toilets (quality of the toilet rooms, separate toilet for males and females)	0.695	1.195	0.109	11.012	0.0001
24	X2	Landscaping (Outdoor Space & Seating, Side Walks Paths, Grass/ Tree/ Plant Areas)	0.684	1.201	0.111	10.873	0.0001
25	X16	Parking Lots (well designed & good lighting to ease Traffic Flow and circulation)	0.680	1.179	.109	10.827	0.0001
26	X1	Layout of Buildings/Stairs/Offices (welcoming entrance, auditoriums/ meetings areas, enough signage inside and outside, well-marked/has lots of signs, wide stairs, well connected and adjacent), additionally offering Dormitories for Students	0.622	1000	000	000	0.0001
27	X21	Availability of Printing & Photocopying Service in the Library	0.620	1.123	0.112	10.044	0.0001

Table (5-14.d): Significance of Service Facility Factors to Perceived Quality of Education; Source: (The Researcher) Continued

28	X18	Audio Tape players, CD/DVD players, and TV set for media and educational purposes	0.601	0.974	0.099	9.791	0.0001
29	X17	Functionality of pedagogical centre	0.388	0.560	0.084	6.663	0.0001
30	X19	Availability of Silent Study Areas	0.285	0.348	0.070	4.998	0.0001

5.4.4 Data Clarification

From the previously discussed results, it can be seen that the most effective services‟ facilities that should be assigned the highest prioritization from Top Management when allocating resources for funding budget distribution are: Library Services, Computer Services, Classrooms, Health Care, Sport, and Other premises like transportation, security, and so on. Based on the obtained results, the concluded university service facilities will be used to construct the proposed stimulating modelling tool for Decision-Makers of facility management in the Egyptian Context Higher Education.

5.5 SUMMARY

This chapter gave a complete description of the statistical analysis carried out for the data collected of the directed survey. It emphasized the most crucial facilities related to the perceived quality of education in universities. The next chapter will be dedicated for the illustration of the construction of the proposed model using the system dynamic approach to examine the influnce of the six derived service facilities of the conducted questionnaire on the perceived quality of education in Higher Education.

CHAPTER SIX

MODEL DEVELOPMENT

6.1 INTRODUCTION

System Dynamics translates the qualitative causal models to quantitative stock and flow models. In this chapter, a system dynamics model is established based on the causal loops that have been agreed with facilities experts and verified by the regression analysis. The model produced pertains to all universities. Depending whether they are applied to a public or a private university, the data will change not the structure. By assigning different values to the variables, we can obtain a clear description of the the system‟s behaviour over time and thus provide a decision support tool for facility managers

The following six facilities have been selected for modelling:

1. Library;
2. Computer Labs;
3. Classrooms;
4. Sports;
5. Health Care;
6. Extra Facilities (premises/ security/ transportation).

The structure of this chapter is to do the following four steps for each facility:

a) Construct the causal model

This was an iterative process. An initial model was produced based on researcher‟s experience of over twenty years working in the university. It was then circulated to heads of that particular facility at several universities. Their feedback was noted and a revised model was constructed. This model went through a second feedback cycle before the final model was accepted

b) Using the causal model as a guide to construct the System Dynamic (stock and flow) model
c) Determine the research model‟d data format

In order to obtain the data for the System Dynamics Model, several preliminary discussions took place, with different facilities services administrators and supervisors in the universities

under study. A formal letter was sent to the Deans of the Faculty to get the approval for the researcher to obtain with the data needed for the construction of the proposed System Dynamics Model. Then, the researcher met the head of each facility service in each College to get round figure estimates of funding about the facilities. This differs for private and public universities and is discussed in Chapter Seven. The second type of data that is important is the shape of the table functions used. These determine the behaviour and are different for private and public universities.

d) Check each model for structural consistency

The following tests were suggested by Richardson and Pugh (1989) to guarantee structural consistency. It can be seen that the first five test can be verified by the correct application of POWERSIM. Tests 6 and 7 have to be done for each facility model.

1. Issue Identification verified by the domain experts‟ assessment of the model, the results of simulating the model and policy suggestions; they confirmed that the "right" problem has been identified.

2. Examination of the model structure verified by the Testing of POWERSIM equation report and the acquisition of approval.

3. Examination of the model parameter verified by Test Domain expert evaluation of empirical and assumed data; approval was attained.

4. Dimensional Consistency Test verified by POWERSIM model check; as all tests at the individual equations were passed and a large system of dimensionally consistent equations resulted.

5. Behaviour Sensitivity verified by Test POWERSIM sensitivity simulation report; rational results were obtained.

6. Extreme Condition Tests verified by the acceptance of results for each equation.

7. Boundary Adequacy Structure identified by Test Domain expert evaluation of system boundaries; approved sound and useful.

For further exemplification, Schwaninger and Grösser (2009) defines "Validation is the operation that throught it we make sure that the model validity is improved systematically. Validation consists of constructing the confidence gradually in the usefulness of a model by

implementing validation tests. In principle, validation spread through all stages of the modelling process, and, besides extends into the stages of model use and implementation." Accordingly, the Structural Validation Tests were conducted in this chapter and additional behavioural or implementation tests were done in Chapter Seven. Each Facility SD model was built and subsequently checked for structural consistency using the tests suggested by Richardson and Pugh 1989 (see table (6-1)). In all six models, the dimensional consistency was guaranteed by the use of Powersim version 10 and also, the boundaries were determined by the field experts" evaluations and the extreme conditions and parameter sensitivity were tested as well.

Table (6-1): Summary Table of Tests Building Confidence in System Dynamics Models; Source: Richardson & Pugh (1989)

	Focusing on Structure	Focusing on Behaviour
Testing Suitability for purpose (testing focusing inward on the model)	1. Dimensional consistency 2. Extreme conditions in equations 3. Boundary adequacy - Important variables - Policy levers	1. Parameter (in) sensitivity - Behaviour characteristic - Policy conclusions 2. Structural (in) sensitivity - Behaviour characteristics - Policy conclusions
Testing consistency with reality (tests comparing the model with information about the real system)	1. Face validity - Stock and flows - Feedback loops - Delays 2. Parameters values - Conceptual fit - Numerical fit	Replication of reference model (boundary adequacy for behaviour) - Problem behaviour - Past polices - Anticipated behaviour - Surprise behaviour
Contributing to the utility and effectiveness of a suitable, consistent model	Audience's Appropriateness model features - Size - Simplicity/complexity - Aggregation/detail	Counter-intuitive behaviour - Exhibited by model - Made intuitive by model based analyses. - Generation of insights

The first case that the model would be developed onto is the Public University (Alexandria University) and the second case that would be studied is the Private University (College of Management & Technology in the Arab Academy of Science & Technology). A short background on both universities is given in the proceeding chapter seven.

6.2 MODELLING FACILITIES

In the preceding chapter five, figure (5-3) represented the resultant prioritised service facilities, which were identified through the regression analysis and after referring to the experts: library services, computer labs, classrooms, health care, sport, and extra facilities

such as transportation, security, safety. The figure below is the finalized refined causal model. Each of these facilities individually affects the degree of student satisfaction, and accordingly the quality of educational service provided but they are also interconnected and the total effect of all of the six categories together needs to be investigated as shown below.

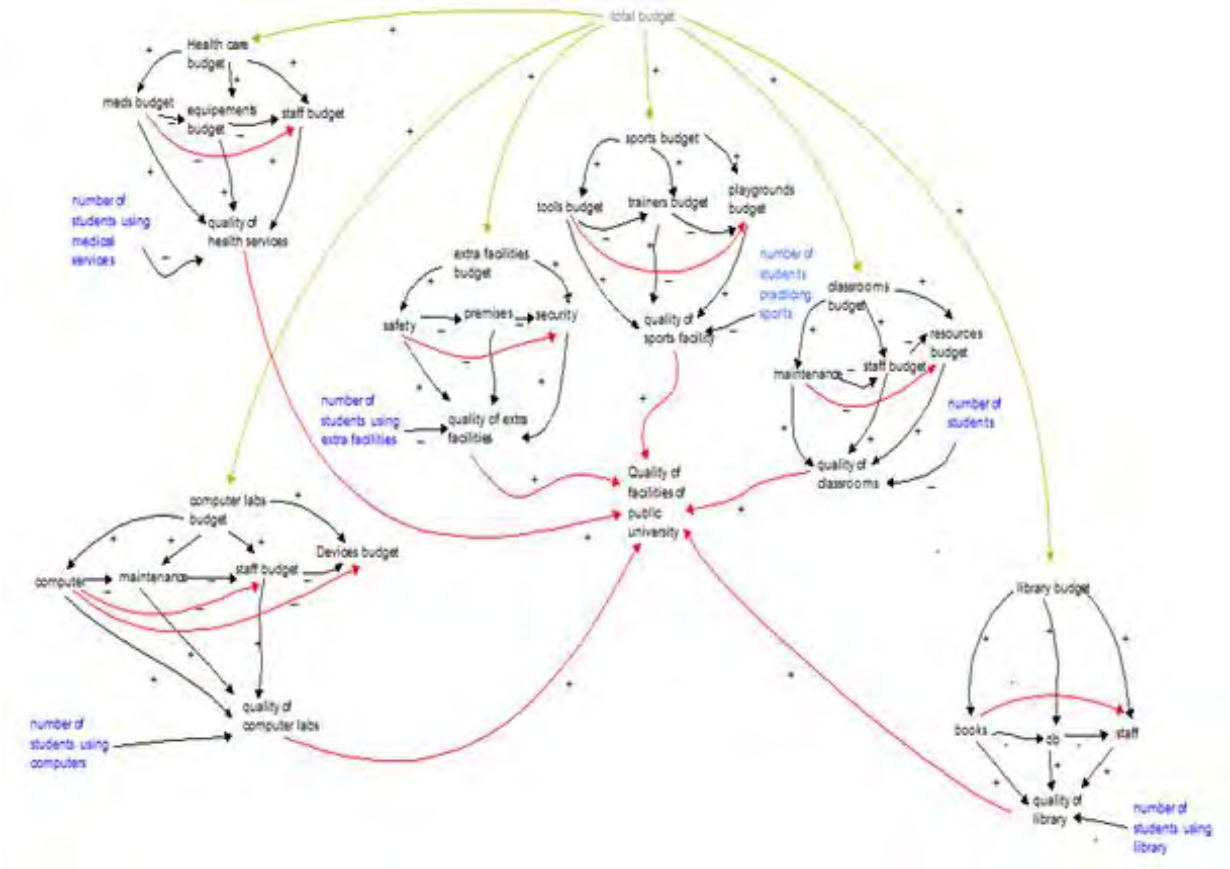


Figure (6-1): Final Refined Model General Causal Loop; Source: (The Researcher)

6.2.1 LIBRARY SERVICES

6.2.1.1 Step 1 Creating the Causal Model for Library Services

Figure (6-2-a) represent a causal model of the Library facility that covers three basic fields; buying books, scientific databases addition, and employees‟ salaries or hiring new employee. Any increase in budget will positively influence the availability of books‟ quantities, databases or staff. As the number of books and databases accessible to students increase, the quality of the library services increase.

The causal loop model, shown in figure (6-2-a), illustrates the realtionship between the the library‟s variables in details.

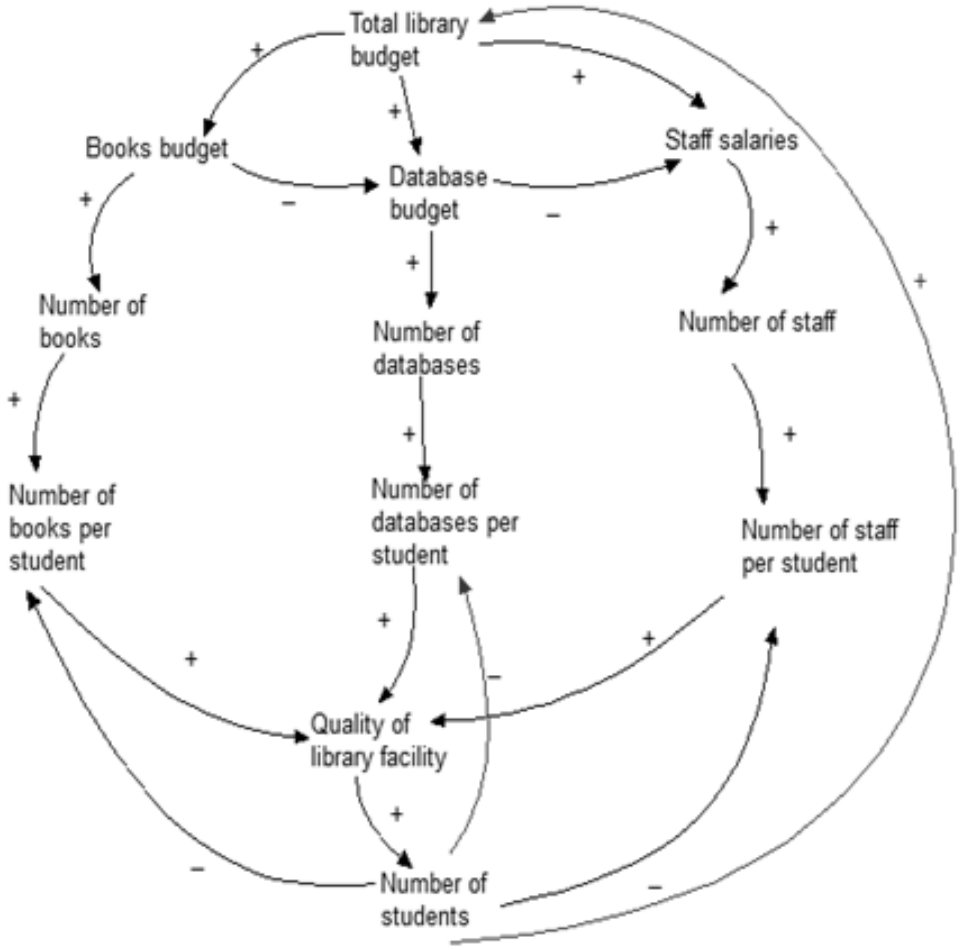


Figure (6-2-a): Library Services Causal Model; Source: (The Researcher)

6.2.1.2 Step 2 Creating System Dynamics Model for Library Services

The three main categories of the services provided by library are books availability, databases and administrative employees. The required number of new books to buy specified in accordance to the amount of available budget for buying books and the average cost per book. Any increase in the quantity of books available in the library should positively influence the quality of the library. On the other hand, employees‟ salaries and additional databases in the library are necessary for the library‟s quality. Since they all share the same budget, thus any increase in the books‟ budget will decrease the amount for salaries and databases. The main use of the developed model is to help in keeping balance between all the factors influencing the quality. The average salaries of employees and the additional number of employees, beside the number of retiring employees hypothetically, constitute the employees budget. The System Dynamics model for the total library Services is shown in figure (6-2-b). The model demonstrates how the quality is affected by the budget for books,

databases and staff salaries. The stocks are the total budget and the number of staff, books and databases. These have an initial value, which is set at the current figures. A budget is allocated for the library and this is divided into separate budgets for staff salaries, books and databases by using three weights wb, wdb and ws, which are initially calculated from the current value. These three weights must always be add to unity so if one weight is increased, the others are changed. The model then uses these stocks individually to estimate its effect on quality by using table functions, data for which has been gathered from questionnaires shown in the Appendix C.

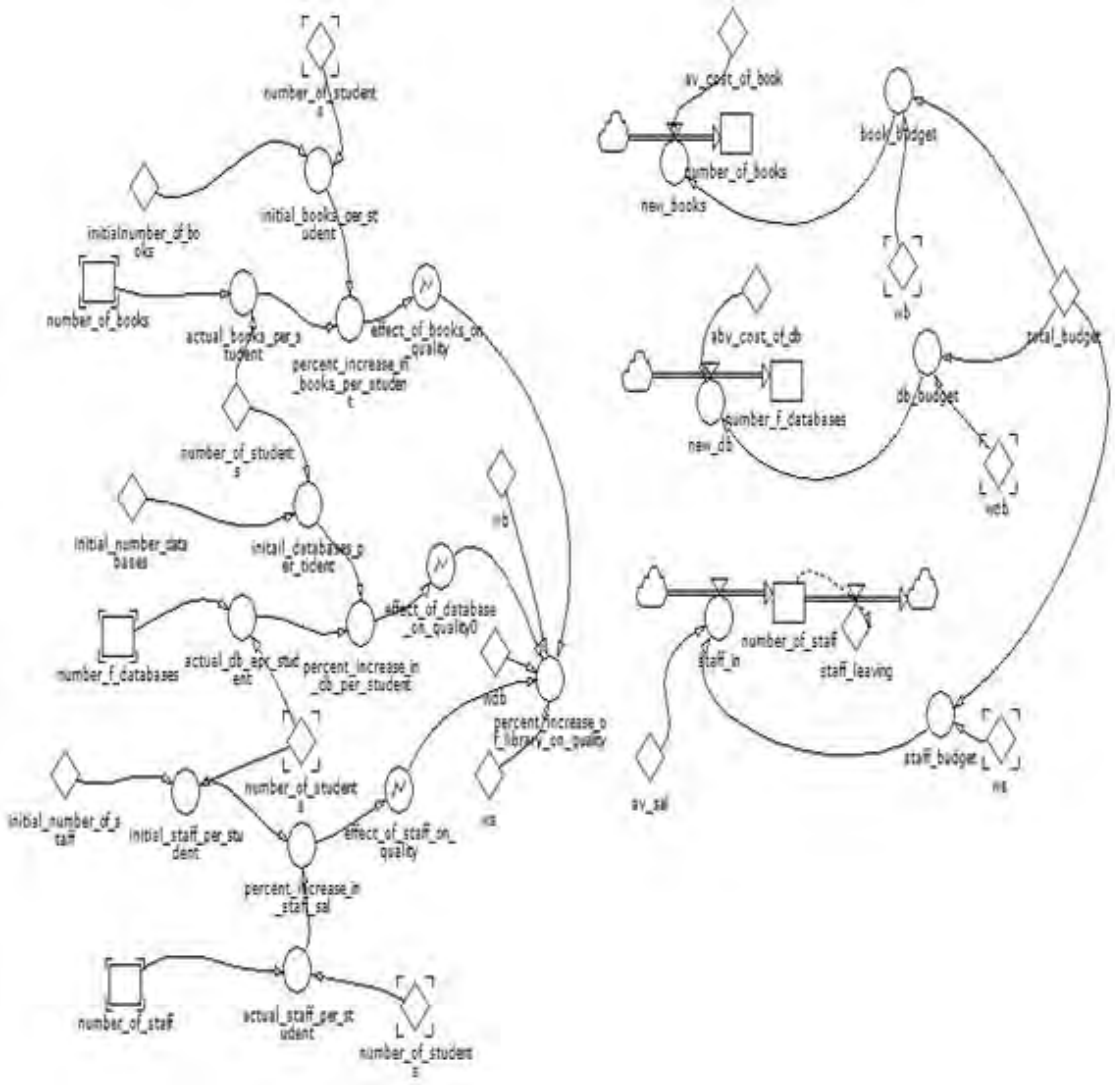


Figure (6-2-b): Library Services Stock & Flow Diagram; Source: (The Researcher)

6.2.1.3 Step 3a Table Functions Used for Library Services for PUBLIC University

This table function relates the purchase of books to quality. If there is no any increase then the impact on quality is zero. A five percent increase will raise the quality by 80% and the

increase then to 100% is linear. This is the normal s-shaped behaviour connected to limited resources. The evidence for the coming graph functions is taken from facility manager interview, which is listed in Appendix D.

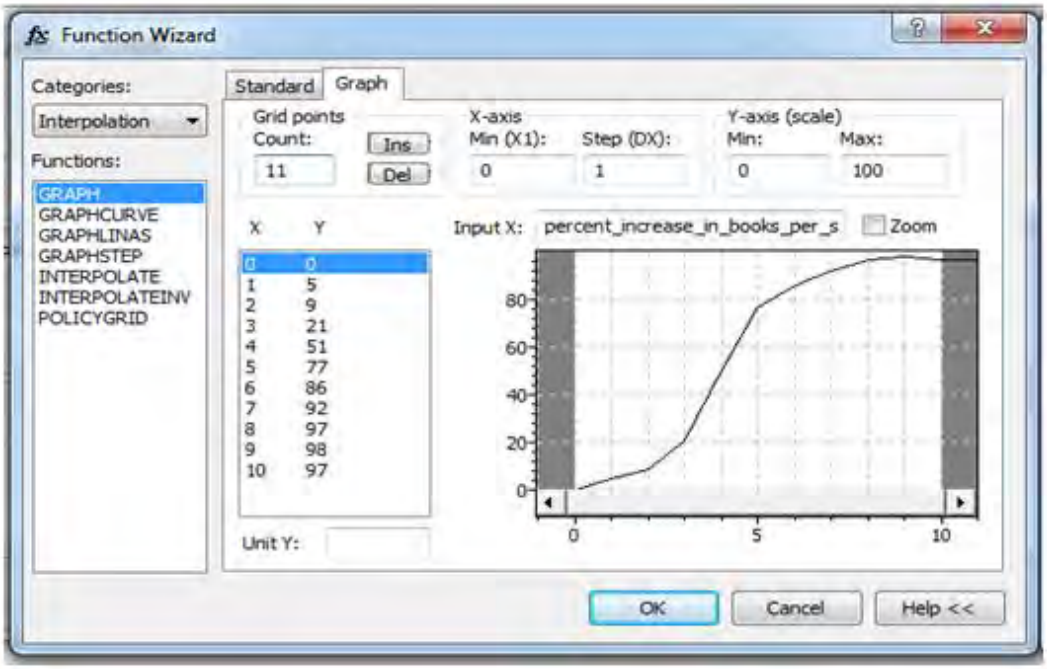


Figure (6-2-c): Books Factor Effect on Estimated Quality; Source: (The Researcher)

This table function relates the percentage increase in staff salary to quality. It is presumed that (all other factors being equal) there is a linear relationship between an increase in salary and increase in quality.

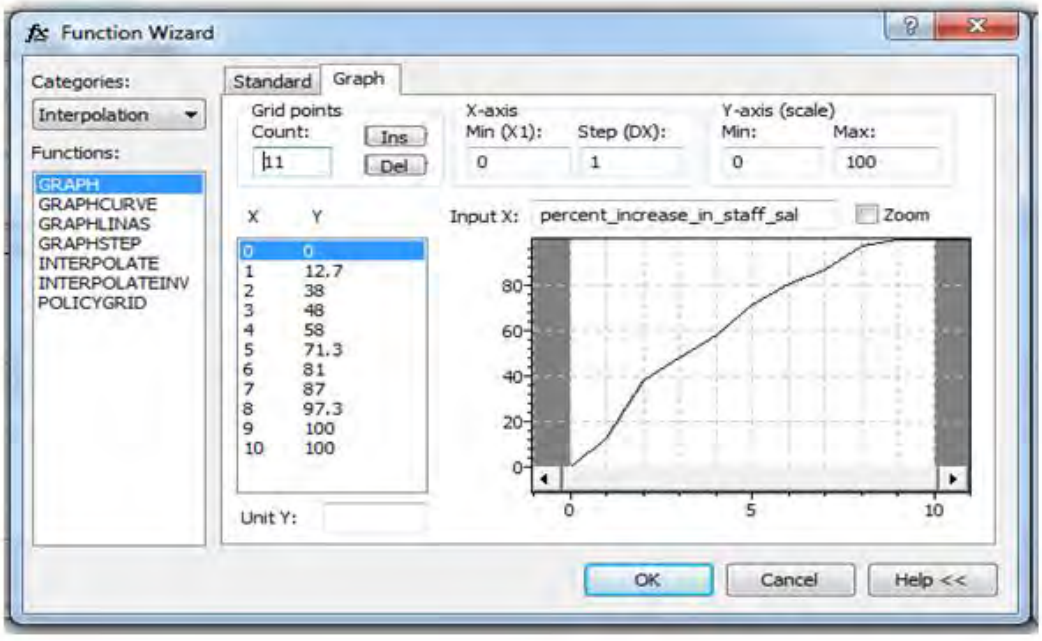


Figure (6-2-d): Staff Factor Effect on Estimated Quality; Source: (The Researcher)

For the vast improvements and changes in nowadays technology, databases had its effect on the perceived quality as well. More databases in ratio to the number of students mean better information. With the percent of increase of the number of databases in relevance to students annually, quality of the library increases. The data on which the above graph is based was obtained from questionnaire 1 shown in the Appendix C. It is approximately linear.

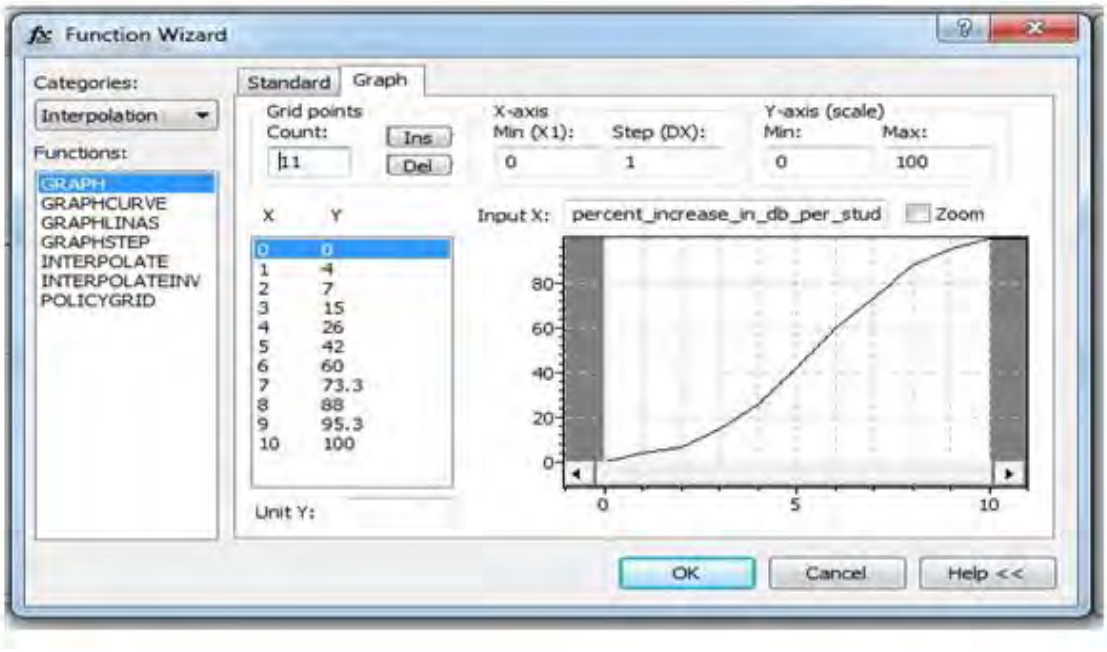


Figure (6-2-e): Database Factor Effect on Estimated Quality; Source: (The Researcher)

6.2.1.3 Step 3b Table Functions Used for Library Services for PRIVATE University

The following figures explain the influence on estimated quality of each factor for the Library service facility for private university. For students to have a diversity of books is always an enhancement. Therefore, every 10% increase of number of books with a student, lead to more than 80% increase of the archived quality.

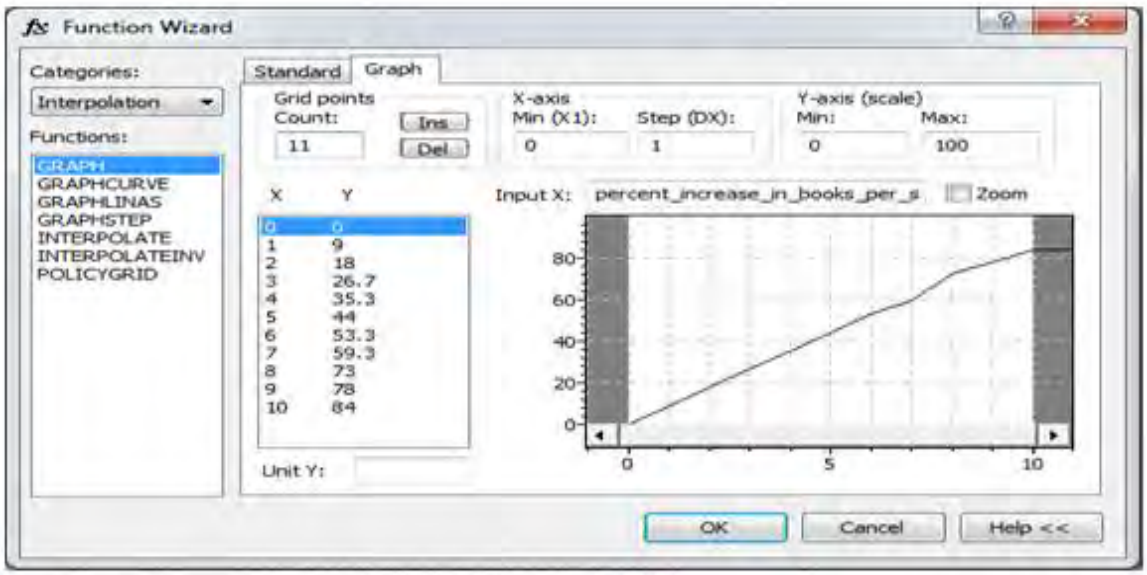


Figure (6-2-f): Books Factor Effect on Estimated Quality for the Private University; Source: (The Researcher)

It has been noted that as the number of staff increases, students are provided a better service and assistance, an optimum result is reached based on the qualified staff guiding students in the library and correspondingly the salaries they take per month.

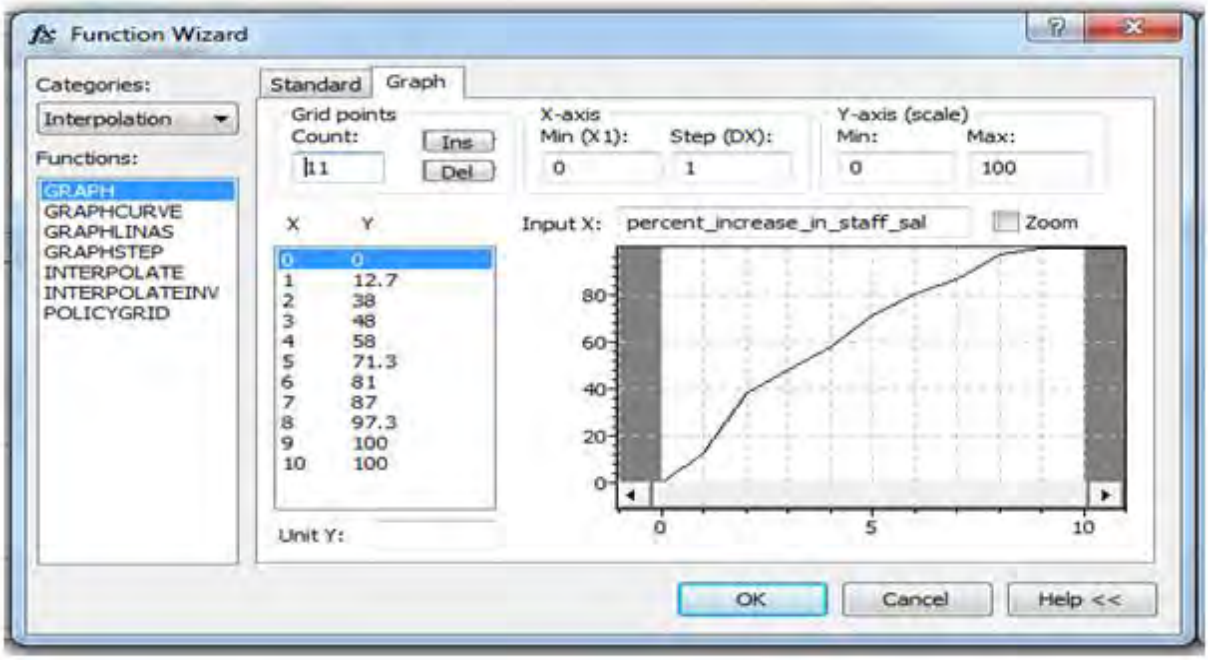


Figure (6-2-g): Staff Factor Effect on Estimated Quality for the Private University; Source: (The Researcher)

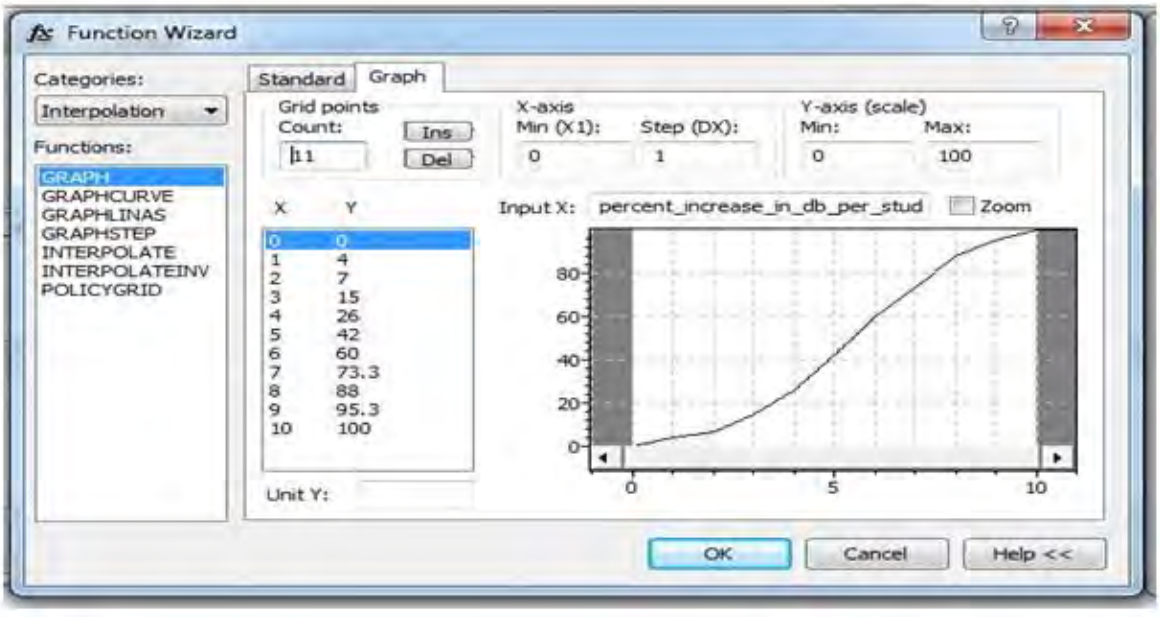


Figure (6-2-h): Database Factor Effect on Estimated Quality for the Private University; Source: (The Researcher)

6.2.1.4 Step 4 Structural Validation of the Libraries Model

6.2.1.4.1 Extreme Conditions (PUBLIC)

The model was run with zero budgets and it gave sensible answer of zero and nothing went wrong. Total budget: initial value: 2066000, minimum value: 0, total quality: 0.

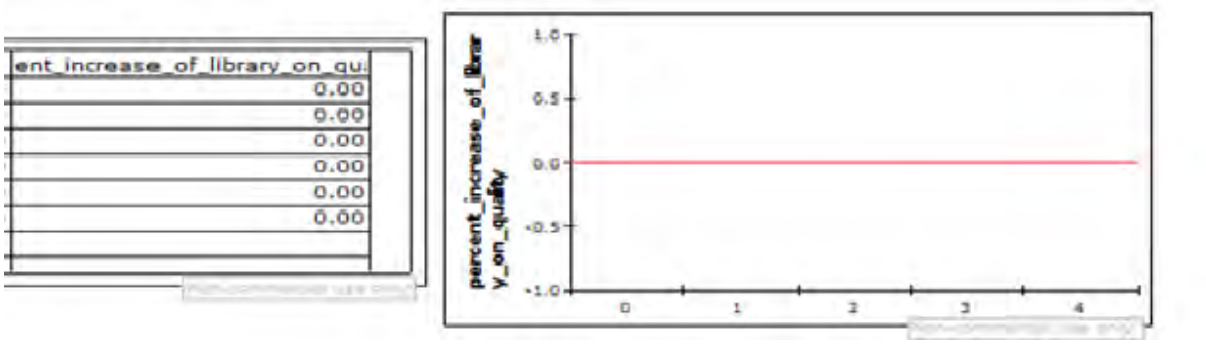
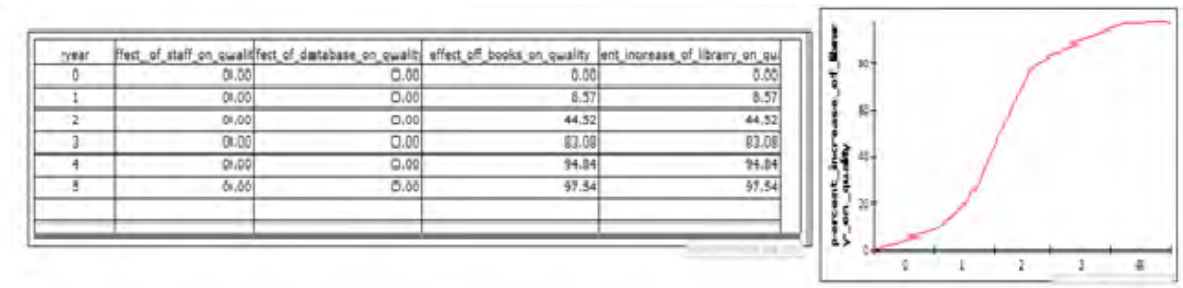


Figure (6-2-i): Extreme Testing Condition for Library Services; Source: (The Researcher)

6.2.1.4.2 Parameter Sensitivity (PUBLIC)

Key parameters were given weights = to 1,0,0 then 0,1,0 then 0,0,1 and no massive changes were caused as shown in next figures.

1-Books: budget initial value: 619800, quality of factor: 62.6, total quality: 37.4, budget maximum value: 2066000, quality of factor: 97.54, total quality: 97.5.



year	ffect_of_staff_on_qualit	ffect_of_database_on_qualit	effect_off_books_on_quality	ent_increase_of_library_on_qu
0	0.00	0.00	0.00	0.00
1	0.00	0.00	8.57	8.57
2	0.00	0.00	44.52	44.52
3	0.00	0.00	83.08	83.08
4	0.00	0.00	94.84	94.84
5	0.00	0.00	97.54	97.54

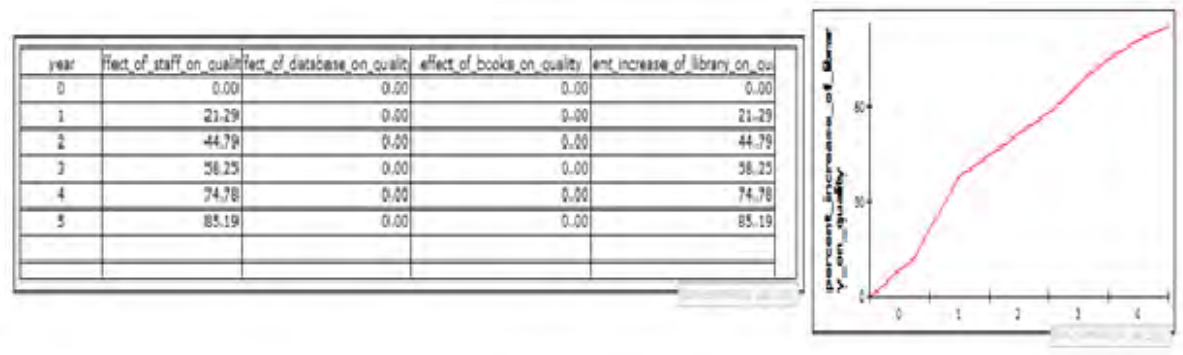
Figure (6-2-j): Parameter Analysis for Books Factor of Library Services; Source: (The Researcher)

2-Databases: budget initial value: 619800, quality of factor: 62.63, total quality: 37.47, budget maximum value: 2066000, quality of factor: 100, total quality: 100.

year	ffect_of_staff_on_qualit	ffect_of_database_on_qualit	effect_of_books_on_quality	ent_increase_of_library_on_qu
0	0.00	0.00	0.00	0.00
1	0.00	28.11	0.00	28.11
2	0.00	89.93	0.00	89.93
3	0.00	100.00	0.00	100.00
4	0.00	100.00	0.00	100.00
5	0.00	100.00	0.00	100.00

Figure (6-2-k): Parameter Analysis for Databases Factor of Library Services; Source: (The Researcher)

3-Staff: budget initial value: 826400, quality of factor: 32.42, total quality: 37.47, budget maximum value: 2066000, quality of factor: 85.19, total quality: 85.1.



year	ffect_of_staff_on_qualit	ffect_of_database_on_qualit	effect_of_books_on_quality	ent_increase_of_library_on_qu
0	0.00	0.00	0.00	0.00
1	21.29	0.00	0.00	21.29
2	44.79	0.00	0.00	44.79
3	58.25	0.00	0.00	58.25
4	74.78	0.00	0.00	74.78
5	85.19	0.00	0.00	85.19

Figure (6-2-l): Parameter Analysis for Staff Factor of Library Services; Source: (The Researcher)

Key parameters were chosen and their values changed slightly. No large changes in Quality were observed, which means that the parameter was not sensitive.

6.2.1.4.3 Extreme Conditions (PRIVATE)

Figure below shows that the model was run with zero budgets and sensible answer of zero was obtained. Total budget: initial value: 4460600, minimum value: 0, total quality: 0.

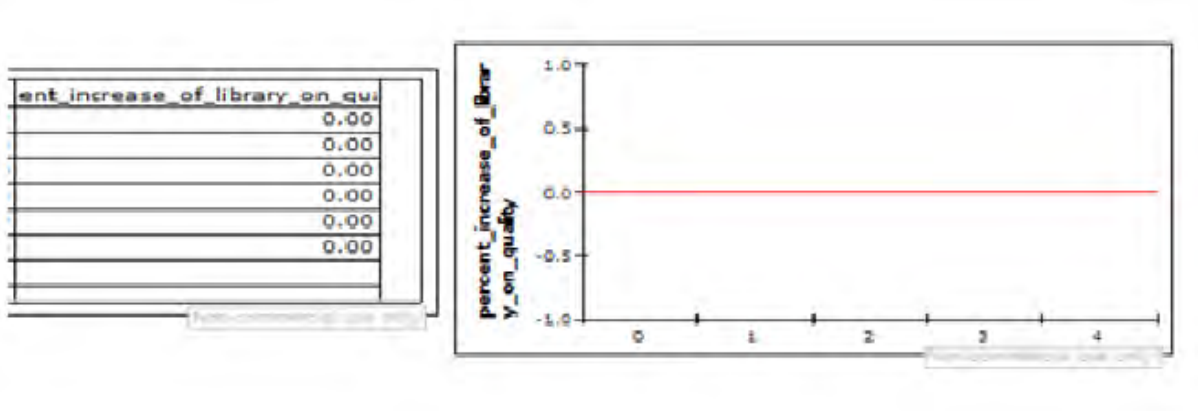
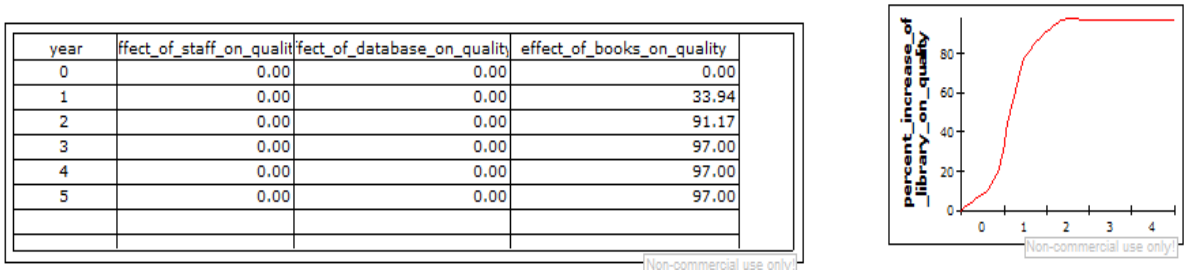


Figure (6-2-m): Extreme Testing Condition for Library Services in the Private University; Source: (The Researcher)

6.2.1.4.4 Parameter Sensitivity (PRIVATE)

The service facility key parameters were given weights = to 1,0,0 then 0,1,0 then 0,0,1 and no massive changes were caused as shown in next figures.

1-Books: budget initial value: 1338180, quality of factor: 78.3, total quality: 71.8, budget maximum value: 4460600, quality of factor: 97, total quality: 97.



year	ffect_of_staff_on_qualit	fect_of_database_on_quality	effect_of_books_on_quality
0	0.00	0.00	0.00
1	0.00	0.00	33.94
2	0.00	0.00	91.17
3	0.00	0.00	97.00
4	0.00	0.00	97.00
5	0.00	0.00	97.00

Figure (6-2-n): Parameter Analysis for Books Factor of Library Services in the Private University; Source: (The Researcher)

2- Database: budget initial value: 1115150, quality of factor: 52.3, total quality: 71.8, budget maximum value: 4460600, quality of factor: 100, total quality: 100.

year	ffect_of_staff_on_qualit	fect_of_database_on_quality	effect_of_books_on_quality
0	0.00	0.00	0.00
1	0.00	33.37	0.00
2	0.00	94.72	0.00
3	0.00	100.00	0.00
4	0.00	100.00	0.00
5	0.00	100.00	0.00

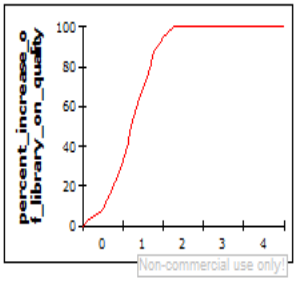


Figure (6-2-0): Parameter Analysis for Database Factor of Library Services in the Private University; Source: (The Researcher)

3-Staff: budget initial value: 2007270, quality of factor: 78.2, total quality: 71.8, budget maximum value: 4466000, quality of factor: 100, total quality: 100.

year	ffect_of_staff_on_qualit	fect_of_database_on_quality	effect_of_books_on_quality
0	0.00	0.00	0.00
1	42.48	0.00	0.00
2	75.13	0.00	0.00
3	98.23	0.00	0.00
4	100.00	0.00	0.00
5	100.00	0.00	0.00

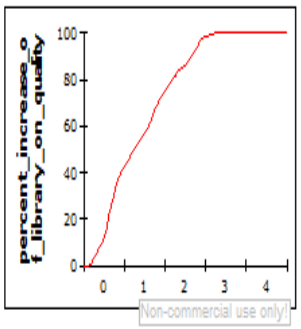


Figure (6-2-p): Parameter Analysis for Staff Factor of Library Services in the Private University; Source (The Researcher)

6.2.2 COMPUTER LABS

6.2.2.1 Step 1 Creating the Causal Model for Computer Labs

The assigned budget for the computer labs is distributed on the computer equipment‟s, maintenance of the labs‟ devices and qualified employees‟ salaries. Although the budget that the university assigned to the labs is fixed, but its allocation is variable. The correlation between the basic factors is negative which mean that if the budget for the computer equipment‟s increase, the budget assigned for maintaining the labs‟ devices and the employees‟ salaries will decrease, and vice versa. The relationship between the quality and the budget assigned to the three factors is positively proportional, which means any increase in the budgets will result in an increase in quality. However, the relationship between the quality and student numbers is negative ratio which mean the increase in the students‟ number will lead to quality decrease. Therefore, for that negative relationship, and in order to increase the quality any increase in the number of students must result in acquiring new equipment‟s,

frequent maintenance of the PCs due to higher usage rate and extra employees to follow up with them. The causal model explaining those relationships is showed Figure (6-3-a) below.

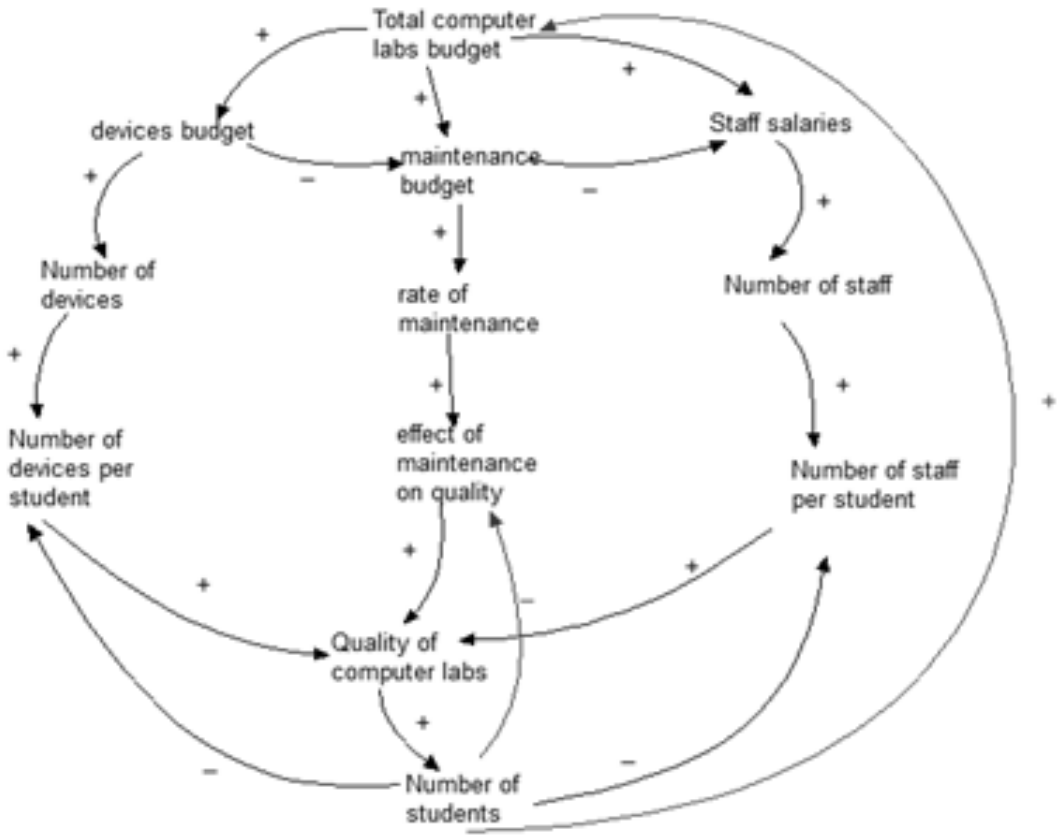


Figure (6-3-a): Computer Labs Causal Model; Source: (The Researcher)

6.2.2.2 Step 2 Creating System Dynamics Model for Computer Labs

In the computer labs System Dynamics model used in buying new computer equipment"s, maintaining labs devices and paying employees" salaries. The budget assigned to computers equipment"s includes the cost of new programme for 250 weeks, which represents the time duration of this model. The number of new programmes applications to be purchased building a factor in computer labs service. As the required money needed for computers budget increased, the available money amount for maintenance and staff salaries will decrease. This concept should be taken in consideration when calculating the maintenance budget, where the cost of maintenance is another factor in this service facility. Furthermore, the budget for library employee is determined according to the average employee salary and the number of employees, which considered another factor contributing to the service and it

calculated by adding the new employees and deducting the retiring or leaving employees against time.

The System Dynamics model embodied in the stock & flow diagram and the estimated output quality is shown below in the next figures. The model equations are given in the Appendix E.

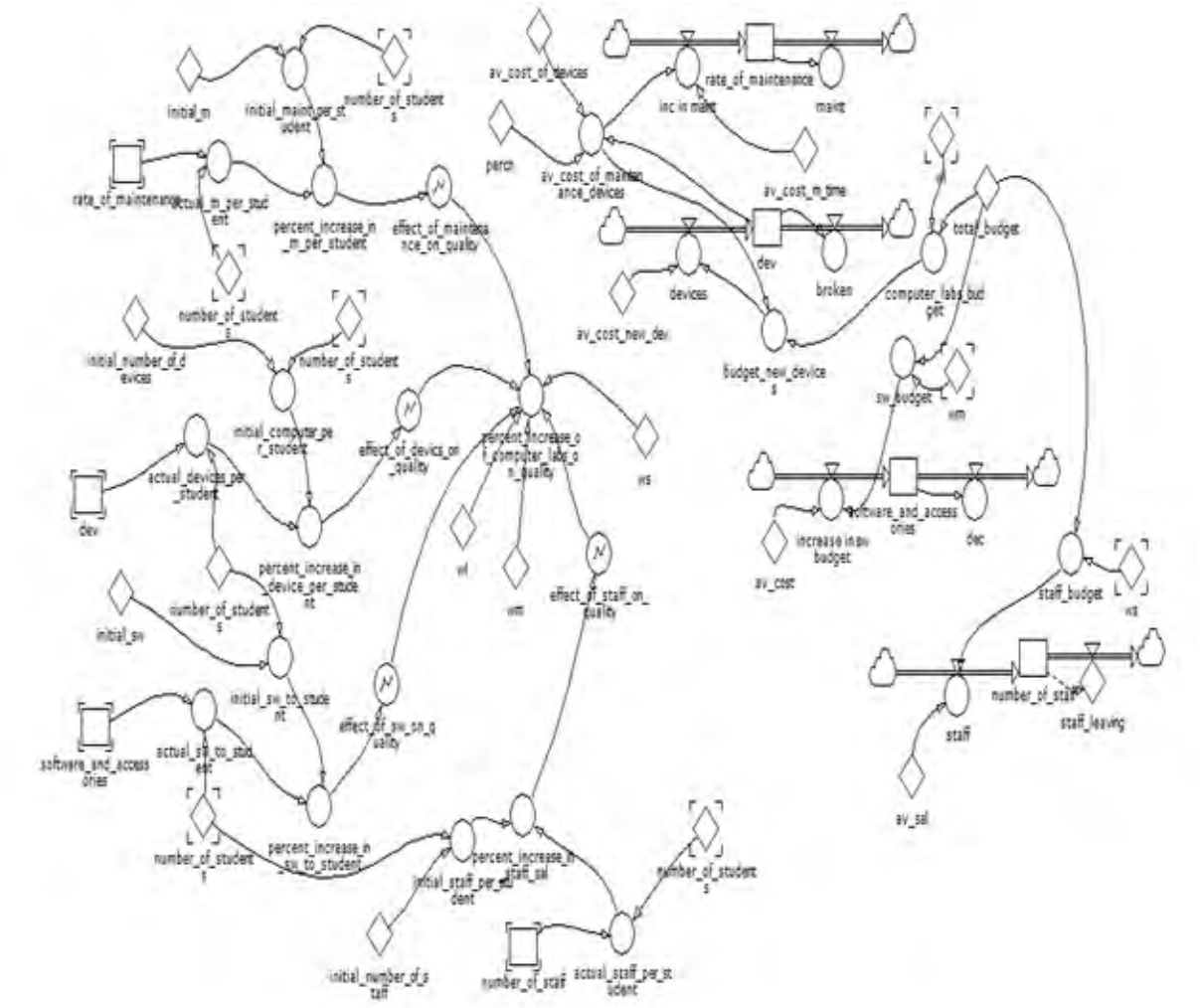


Figure (6-3-b): Computer Labs Stock & Flow Diagram; Source: (The Researcher)

6.2.2.3 Step 3a Table Functions Used for Computer Labs for PUBLIC University

Although the spending from amount of budget that increased over time, but the quality of services will remain constant and the value decrease as the result of the quality being not improved and remaining constant and the increasing in number of students that using the facilities. Figures below show the effect on estimated quality of each factor in the computer labs service facility. The evidence acquired for the following graphs was obtained from the facility manager interview referred to in the Appendix D.

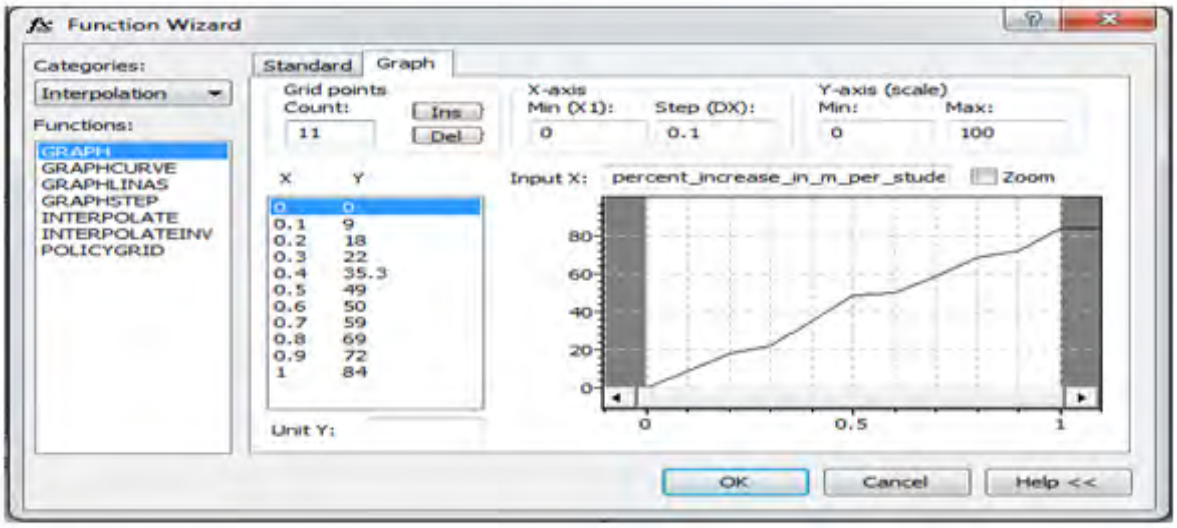


Figure (6-3-c): Maintenance Factor Effect on Estimated Quality; Source: (The Researcher)

A (0-1%) increase in maintenance to students (ratio) leads to reach (0-100%) increase in quality of factor in facility. In other words, for each 100 students to be increased, increase rate of maintenance once annually is needed in addition to the rate achieved. The more students use the labs (usage rate), the faster depreciation takes place, and so maintenance time needs to increase.

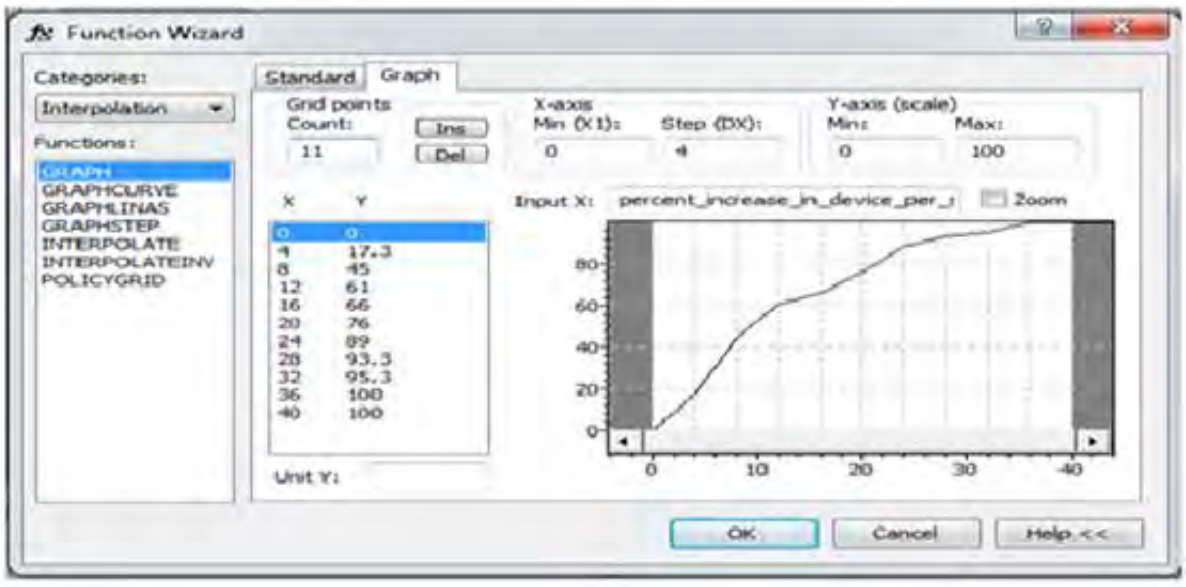


Figure (6-3-d): Devices Factor Effect on Estimated Quality; Source: (The Researcher)

A (0-40%) increase in devices to students‟ ratio leads to reach (0-100%) increase in quality of factor in facility. As number of students using the computer labs is 4200, about only 10% would need to be using the labs simultaneously, so about 420 to achieve is needed so that

each student is using a computer alone. An increase of 40% would reach the 100% quality desired. The rate of increase here is high due to the sensitivity of quality of the whole facility based on the quality of the devices being used. This high impact was clearly noticed by the interview/questionnaire where experts‟ opinions have been put into consideration. Rate tends to decrease by the end of the graph for the increase in the number of devices to students reaches optimum.

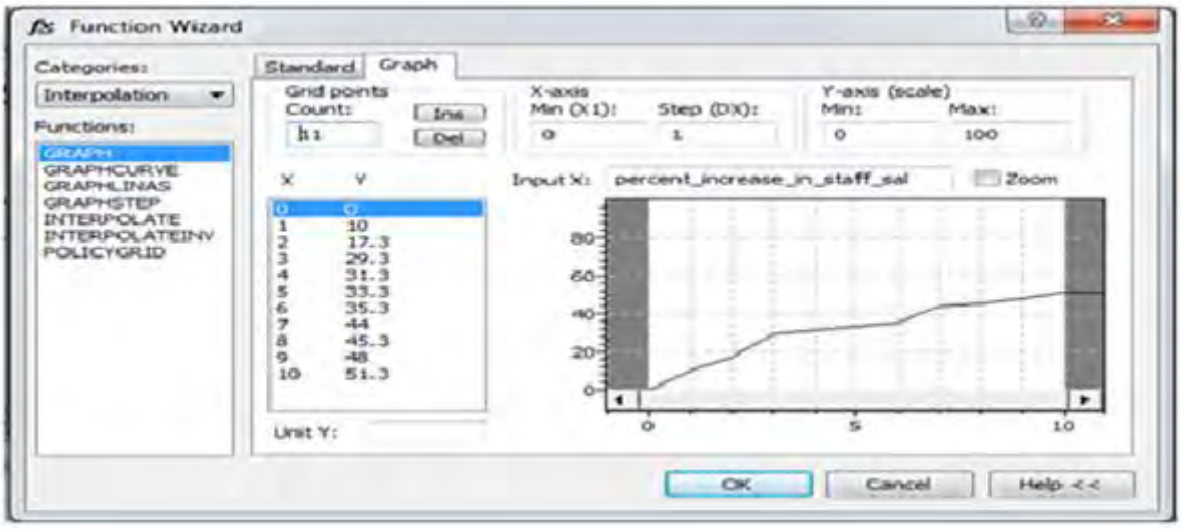


Figure (6-3-e): Staff Factor Effect on Estimated Quality; Source: (The Researcher)

A (0-10%) increase in staff salaries lead to reach (0-51%) increase in quality of factor in facility.Rate of increase is low; almost linear salaries increase rates.

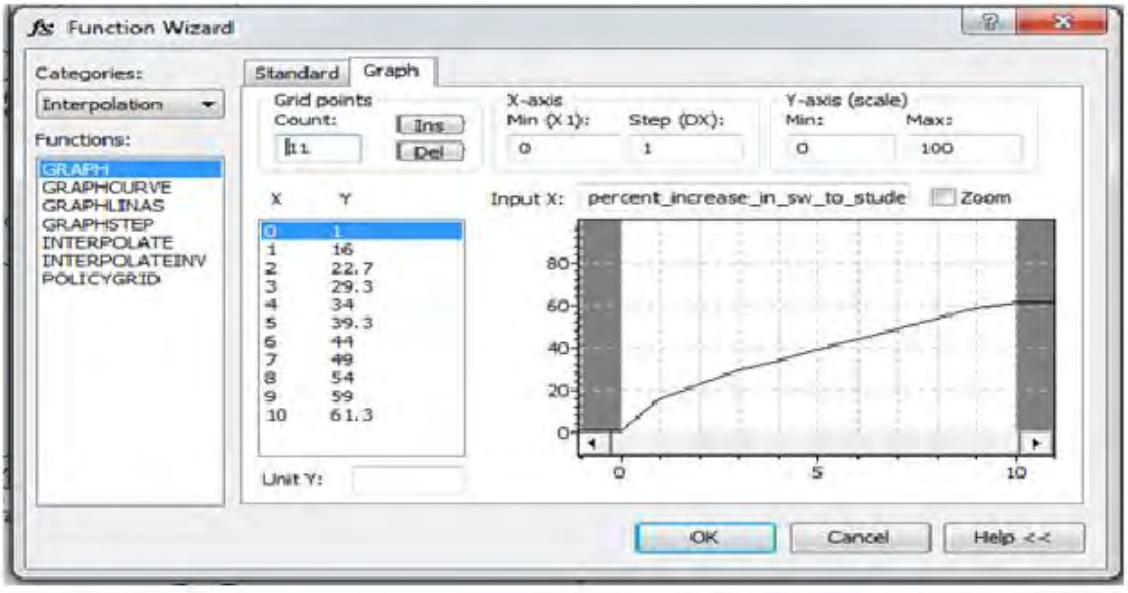


Figure (6-3-f): Software Factor Effect on Estimated Quality; Source: (The Researcher)

A (0-10%) increase in software leads to students‟ ratio to reach (0-61%) increase in quality of factor in facility. Software upgrade is bounded by the available new versions released in the markets. This upgrade is usually not very significant from version to next version. So, maximum percentage of improvement is achieved to be approximately 10% producing an increase in the quality of the service facility about 61% maximum.

6.2.2.3 Step 3b Table Functions Used for Computer Labs for PRIVATE University

The next figures shows the effect on the estimated quality of each factor that constructs the computer labs service facility that collected from private university.

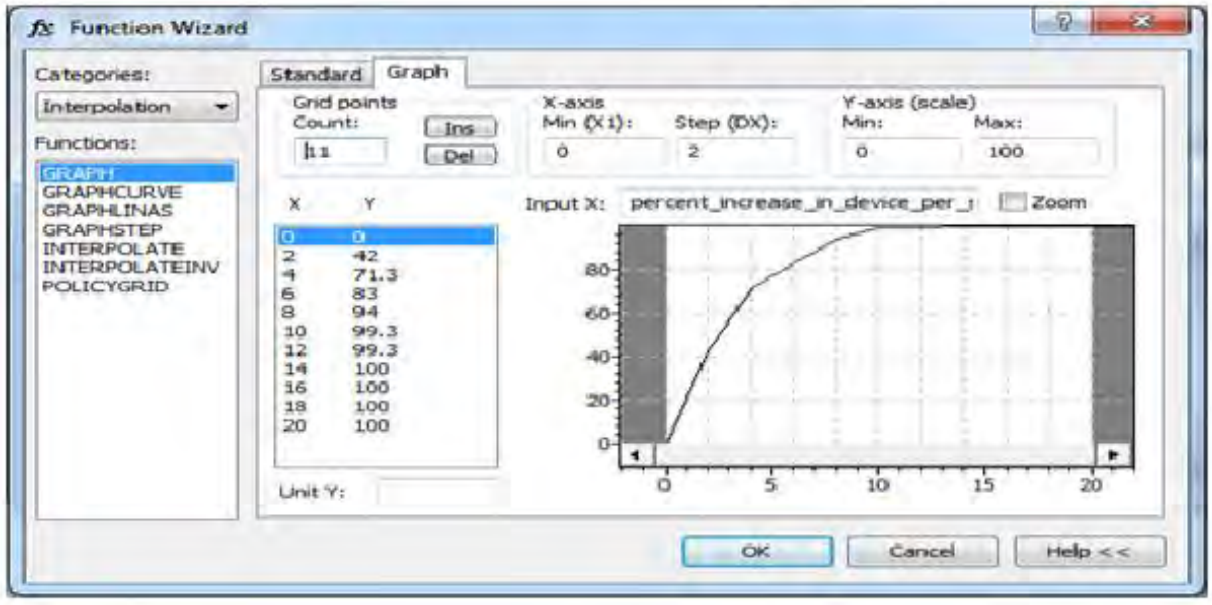


Figure (6-3-g): Equipment's Factor Effect on Estimated Quality for the Private University; Source: (The Researcher)

A (0-20%) increase in devices in reference to students‟ ratio leads to (0-100%) increase in quality of factor in facility. As number of students using the computer labs in the university is 3200, about only 15-20% would need to be using the labs simultaneously thus; about 380 devices are needed so that each student is using a computer alone. Two hundred fifty computer devices are available, so an increase of about 20% would reach the 100% quality desired.

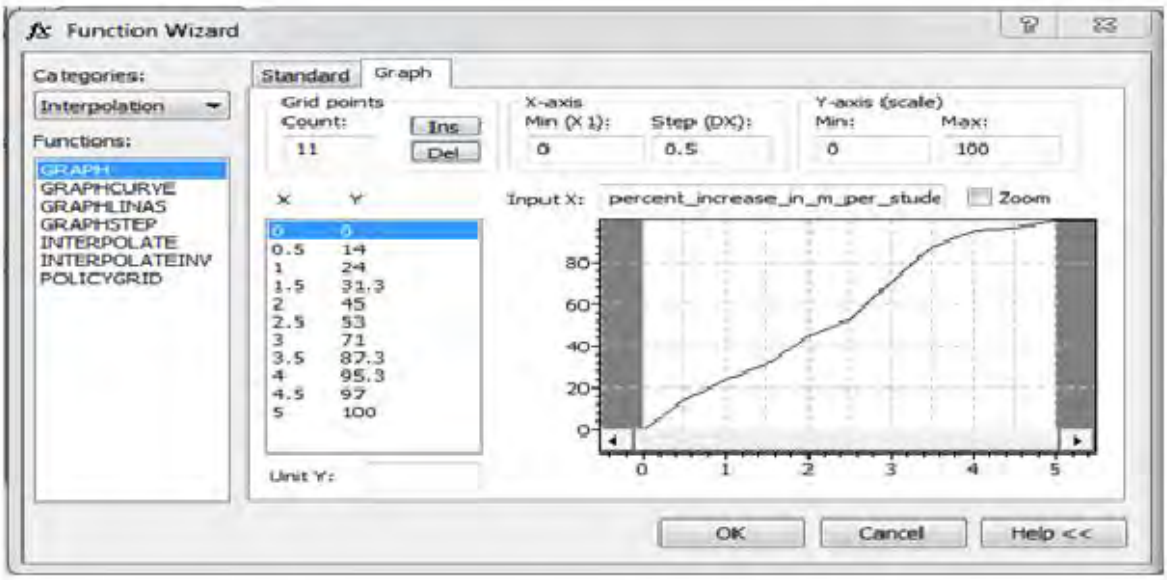


Figure (6-3-h): Maintenance Factor Effect on Estimated Quality for the Private University; Source: (The Researcher)

A (0-5%) increase in maintenance in reference to students‟ ratio leads to (0-100%) increase in quality of factor in facility. In other words, an increase rate of maintenance up to five times is needed annually. The more students use the labs (i.e. usage rate), the faster depreciation takes place, and so maintenance rate should increase.

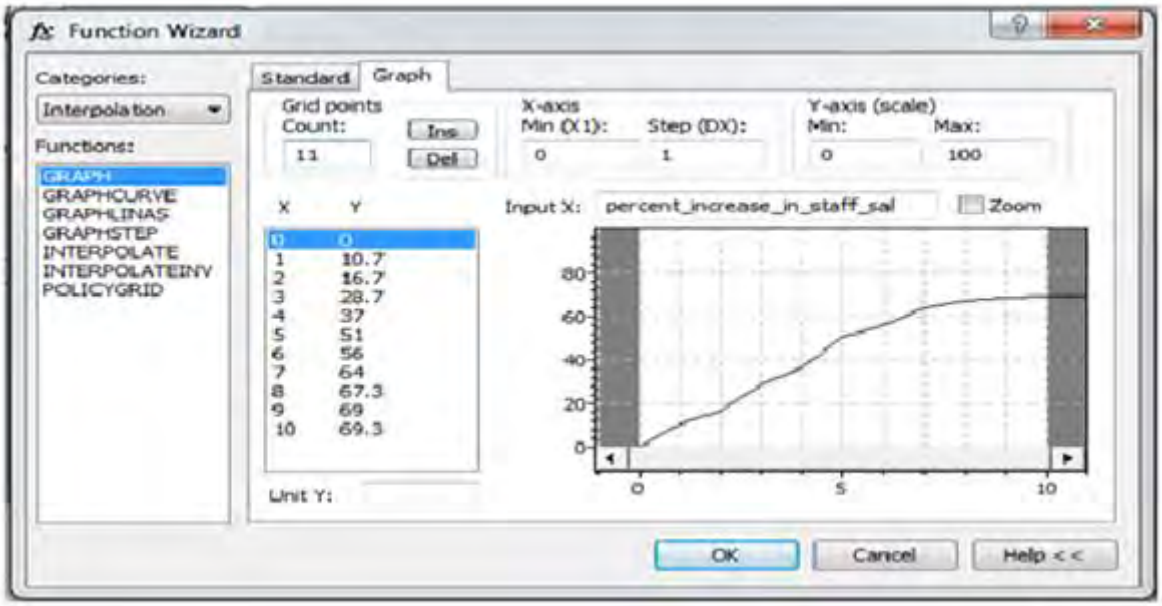


Figure (6-3-i): Employees Factor Effect on Estimated Quality for the Private University; Source: (The Researcher)

A (0-10%) increase in salary causes (0-69.3%) increase in the quality of the service facility factor. Rate of increase is almost linear.

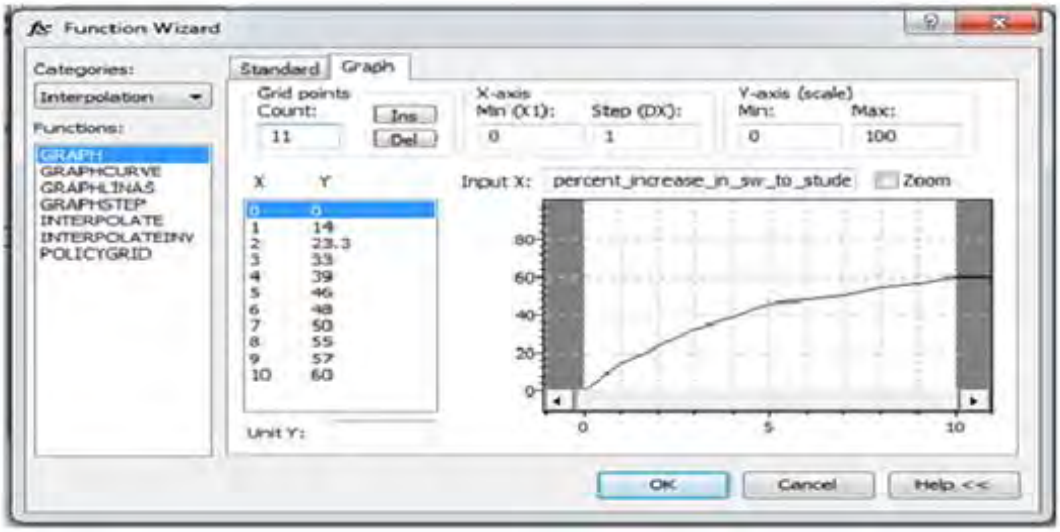


Figure (6-3-j): Software Factor Effect on Estimated Quality for the Private University; Source: (The Researcher)

A (0-10%) increase in software in reference to students" ratio leads to (0-60%) increase in the quality of the facility factor. Software upgrade is bounded by the available new versions released in the markets. This upgrade is usually not very significant from version to very next version. So a maximum percentage of improvement is quantified to be approximately 10%, which will cause increasing quality of facility with about 61% maximum.

6.2.2.4 Step 4 Structural Validation of the Computer Labs Model

6.2.2.4.1 Extreme Conditions (PUBLIC)

Figure (6-3-k) indicates that the model was run with zero budget and sensible answer of zero was displayed. Total budget: initial value: 1334000, initial quality: 87.9, minimum value: 0, total quality: 0.

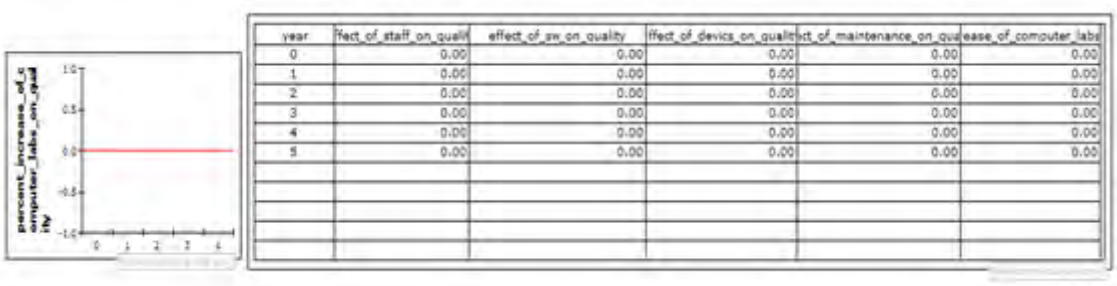


Figure (6-3-k): Extreme Testing Condition for Computer Labs; Source: (The Researcher)

6.2.2.4.2 Parameter Sensitivity (PUBLIC)

The key parameters were chosen and their values changed slightly. No large changes in Quality were observed which means that the parameters were not sensitive.

1-Devices: budget initial value: 133400, quality of factor: 30.3, total quality: 64.4, budget maximum value: 1334000, quality of factor: 100, total quality: 101.

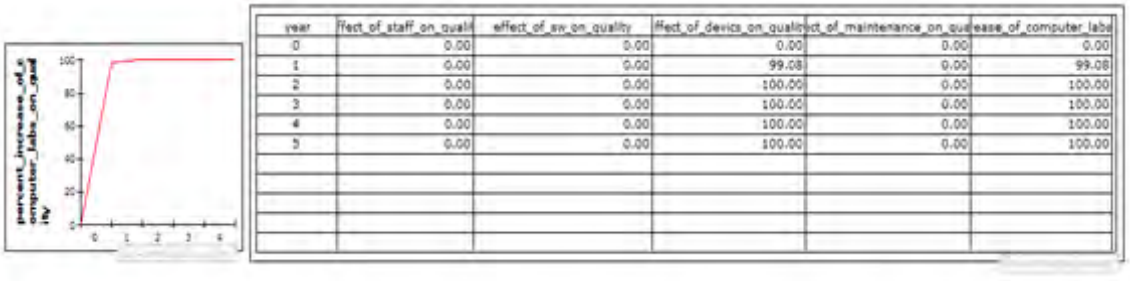


Figure (6-3-l): Parameter Analysis for Devices Factor of Computer Labs; Source: (The Researcher)

2- Software: budget initial value: 533600, quality of factor: 56.1, total quality: 64.4, budget maximum value: 1334000, quality of factor: 100, total quality: 100.

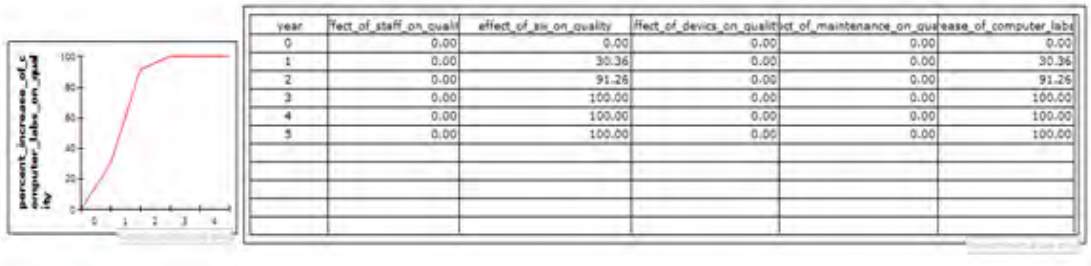


Figure (6-3-m): Parameter Analysis for Software Factor of Computer Labs; Source: (The Researcher)

3-Staff: budget initial value: 667000, quality of factor: 76.9, total quality: 64.4, budget maximum value: 1334000, quality of factor: 100, total quality: 100.

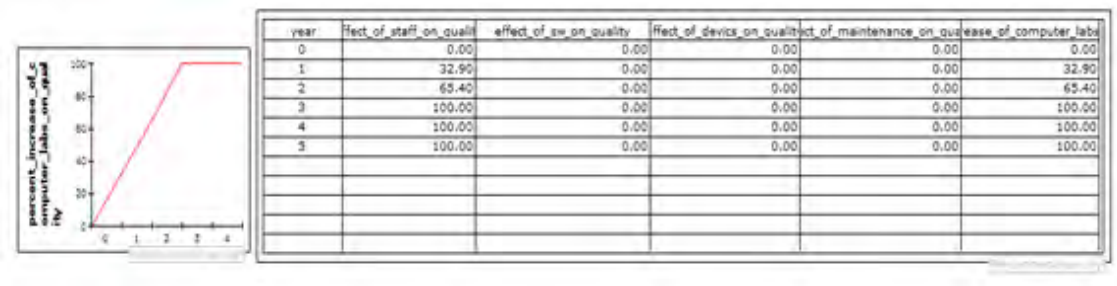
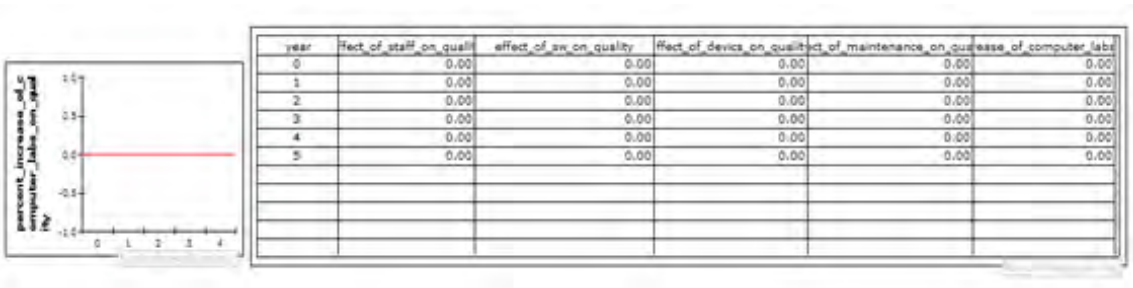


Figure (6-3-n): Parameter Analysis for Staff Factor of Computer Labs; Source: (The Researcher)

Key parameters were chosen and their values changed slightly. No large changes in Quality were observed, which means that the parameter was not sensitive.

6.2.2.4.3 Extreme Conditions (PRIVATE)

Figure (6-3-o) shows that the model was run with zero budget and reasonable answer of zero was attained. Total budget: initial value: 1200000, initial quality: 82.64, minimum value: 0, total quality: 0.



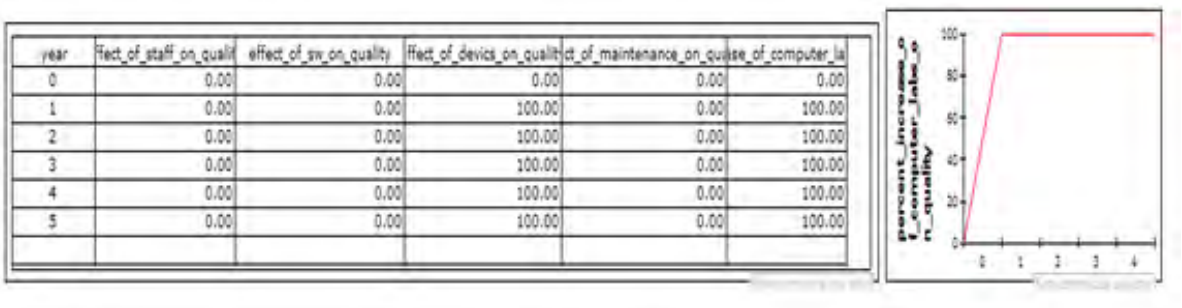
year	ffect_of_staff_on_quali	effect_of_sw_on_quality	ffect_of_devics_on_quali	ct_of_maintenance_on_qu	ease_of_computer_labs
0	0.00	0.00	0.00	0.00	0.00
1	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00

Figure (6-3-o): Extreme Testing Condition for Computer Labs in the Private University; Source: (The Researcher)

6.2.2.4.4 Parameter Sensitivity (PRIVATE)

The computer labs‟ key parameters were assumed to weights = to 1,0,0 then 0,1,0 then 0,0,1 and no massive changes were caused as exposed in the proceeding figures.

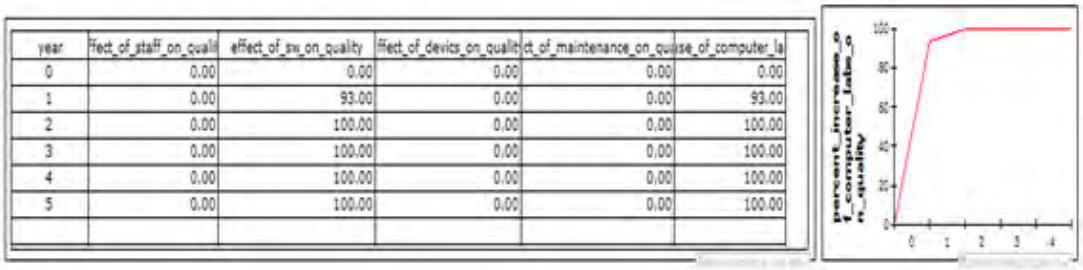
1-Devices: budget initial value: 120000, quality of factor: 93.7, total quality: 82.64, budget maximum value: 1200000, quality of factor: 100, total quality: 101.



year	ffect_of_staff_on_quali	effect_of_sw_on_quality	ffect_of_devics_on_quali	ct_of_maintenance_on_qu	ease_of_computer_la
0	0.00	0.00	0.00	0.00	0.00
1	0.00	0.00	100.00	0.00	100.00
2	0.00	0.00	100.00	0.00	100.00
3	0.00	0.00	100.00	0.00	100.00
4	0.00	0.00	100.00	0.00	100.00
5	0.00	0.00	100.00	0.00	100.00

Figure (6-3-p): Parameter Analysis for Devices Factor of Computer Labs in the Private University; Source: (The Researcher)

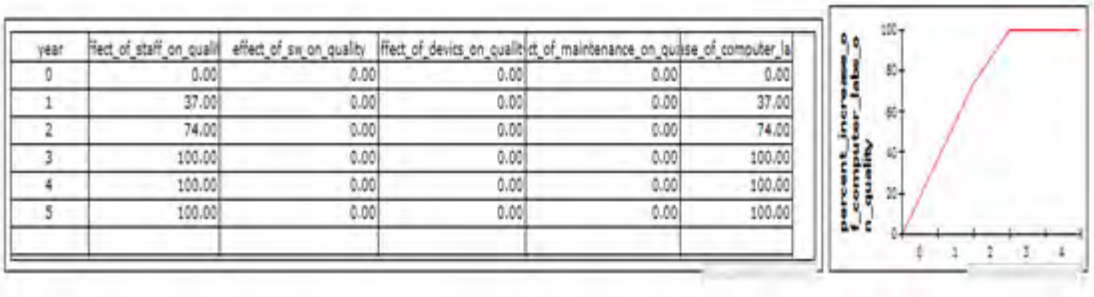
2- Software: budget initial value: 480000, quality of factor: 95, total quality: 82.64, budget maximum value: 1200000, quality of factor: 100, total quality: 100.



year	ffect_of_staff_on_quali	effect_of_sw_on_quality	ffect_of_devics_on_quali	ct_of_maintenance_on_qu	se_of_computer_la
0	0.00	0.00	0.00	0.00	0.00
1	0.00	93.00	0.00	0.00	93.00
2	0.00	100.00	0.00	0.00	100.00
3	0.00	100.00	0.00	0.00	100.00
4	0.00	100.00	0.00	0.00	100.00
5	0.00	100.00	0.00	0.00	100.00

Figure (6-3-q): Parameter Analysis for Software Factor of Computer Labs in the Private University; Source: (The Researcher)

3-Staff: budget initial value: 600000, quality of factor: 69.95, total quality: 64.4, budget maximum value: 1200000, quality of factor: 100, total quality: 100.



year	ffect_of_staff_on_quali	effect_of_sw_on_quality	ffect_of_devics_on_quali	ct_of_maintenance_on_qu	se_of_computer_la
0	0.00	0.00	0.00	0.00	0.00
1	37.00	0.00	0.00	0.00	37.00
2	74.00	0.00	0.00	0.00	74.00
3	100.00	0.00	0.00	0.00	100.00
4	100.00	0.00	0.00	0.00	100.00
5	100.00	0.00	0.00	0.00	100.00

Figure (6-3-r): Parameter Analysis for Staff Factor of Computer Labs in the Private University; Source: (The Researcher)

6.2.3 CLASSROOMS

6.2.3.1 Step 1 Creating the Causal Model for Classrooms

Figure (6-4-a) shows the classrooms causal model. Classrooms budget represents the amount of money spent on maintenance of educational resources available in classrooms like (air conditioning / lighting / data shows … etc) and salaries of the staff. Logically, increasing the amount of money expended on these resources will improve the quality of classrooms, but as the number of students rises, this will negatively affects the quality since there is a limited classrooms space available.

Additionally, the long working hours due to the increasing number of students, starting from 8:00 am until 8:00 pm, six days per week will also negatively affect the quality of classrooms. Thus, the relationship between the increase in number of students and quality is a negative one. On the other hand, the staff salaries is also essential to the quality of the classrooms, as it will provide more staff to teach the increasing number of students and as

their salaries increase they would be more enthusiastic to teach. However, a balance between the budget of maintenance and that of staff salaries is needed, as they are inversely proportional to each other since they share the same fixed budget.

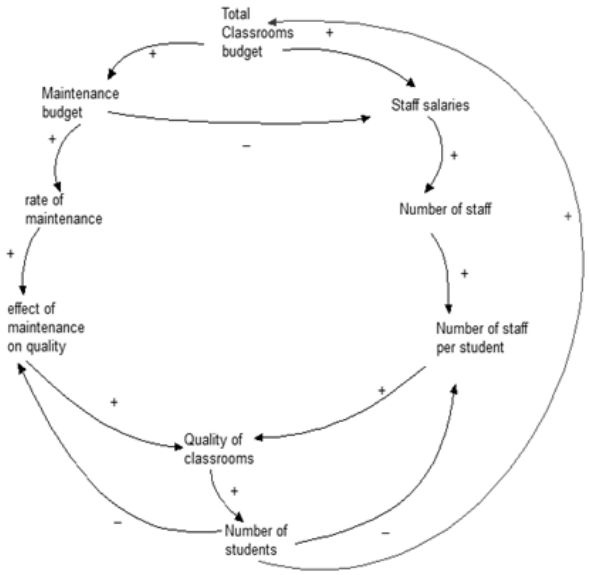


Figure (6-4-a): Classrooms Causal Model; Source: (The Researcher)

6.2.3.2 Step 2 Creating System Dynamics Model for Classrooms

The Stock & Flow Diagram is shown in Figure (6-4-b).

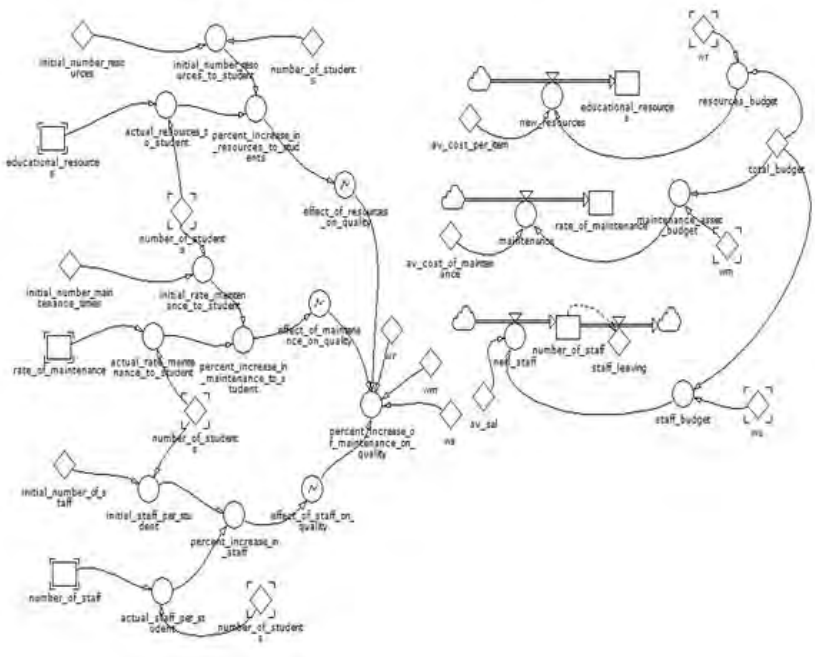


Figure (6-4-b): Classrooms Stock & Flow Diagram; Source: (The Researcher)

6.2.3.3 Step 3a Table Functions Used for Classrooms for PUBLIC University

The subsequent figures display the output screens for the supported factors. The data comprehended for the graphs functions below came from the conducted facility manager interview denoted in the Appendix D.

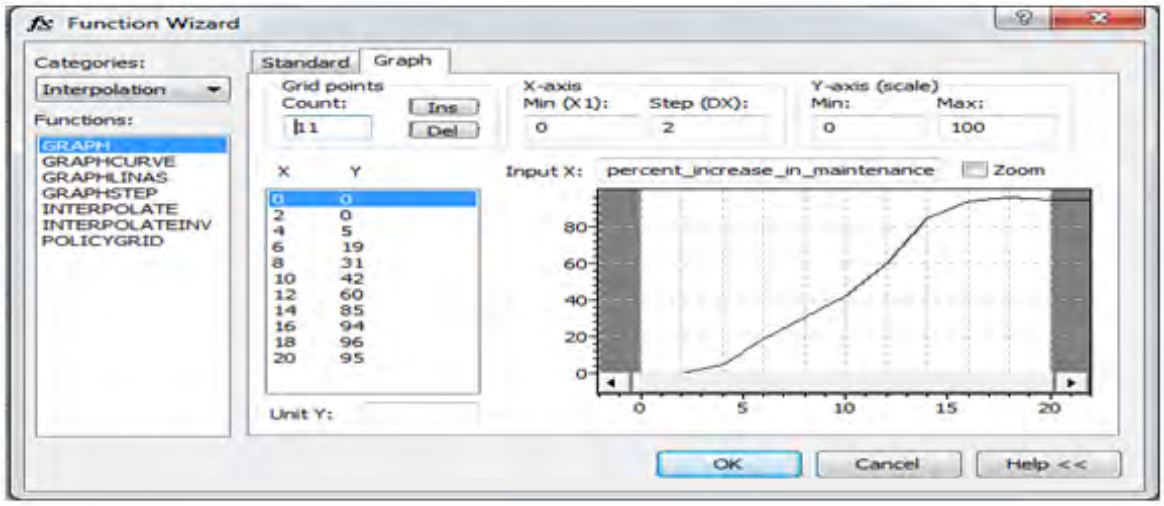


Figure (6-4-c): Maintenance Factor Effect on Estimated Quality; Source: (The Researcher)

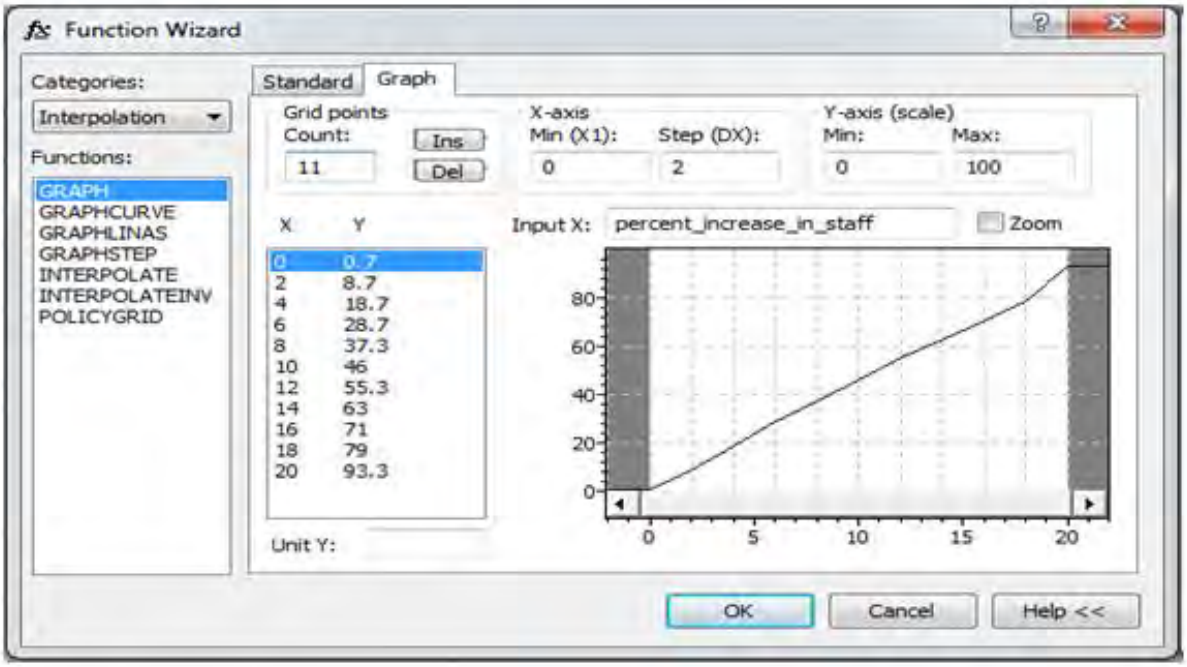


Figure (6-4-d): Staff Factor Effect on Estimated Quality; Source: (The Researcher)

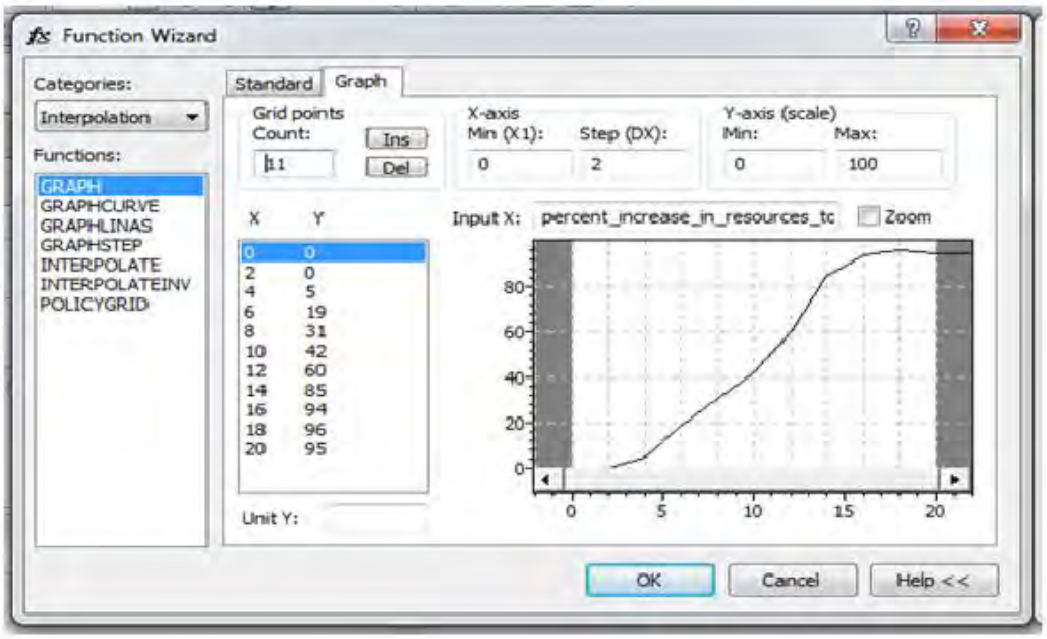


Figure (6-4-e): Educational Resources Factor Effect on Estimated Quality; Source: (The Researcher)

6.2.3.3 Step 3b Table Functions Used for Classrooms for PRIVATE University

The following graphs show the output from the perceived quality of the factors that contribute to this service facility. The more students who enrol in the university, the more periodical maintenance rate is needed.

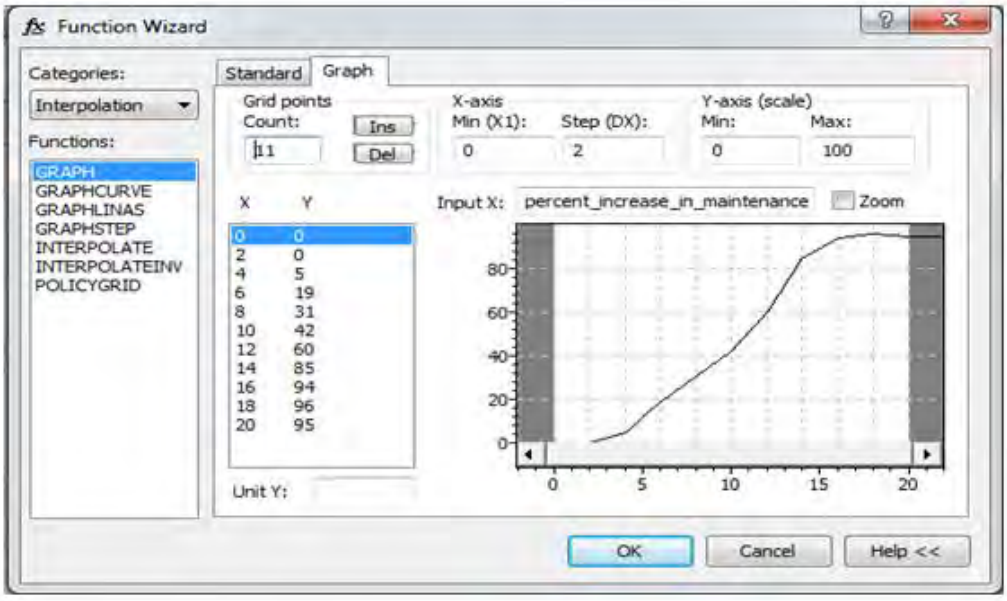


Figure (6-4-f): Maintenance Factor Effect on Estimated Quality for the Private University; Source: (The Researcher)

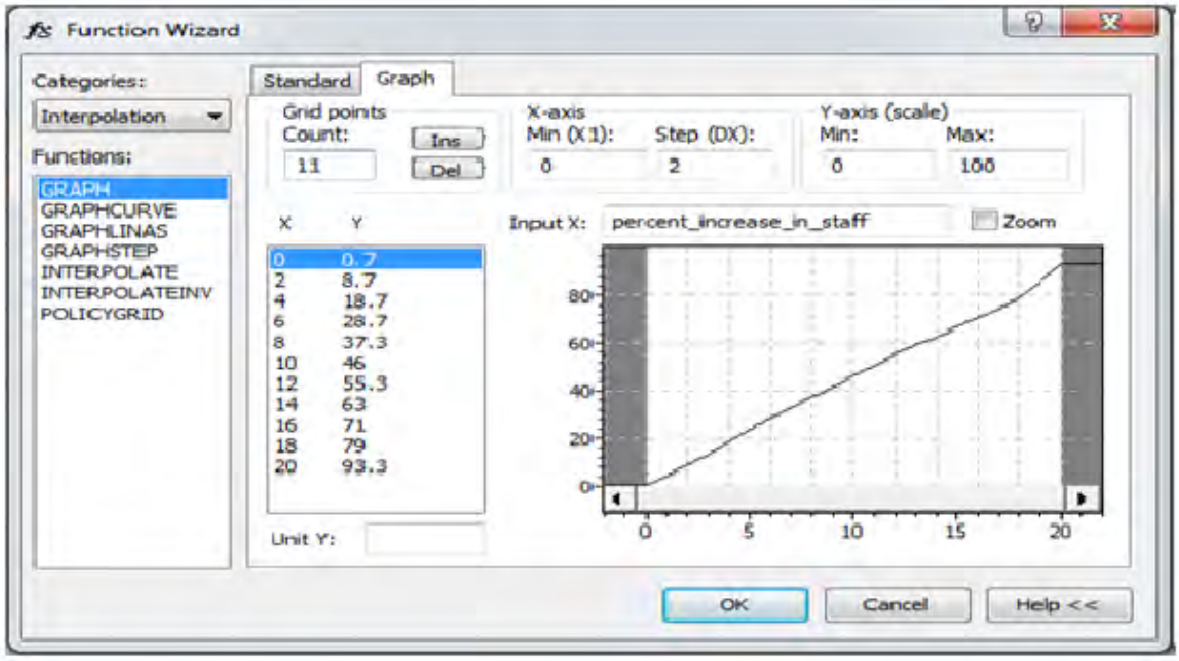


Figure (6-4-g): Staff Factor Effect on Estimated Quality for the Private University; Source: (The Researcher)

For students to receive proper quality of education a classroom should be an adequate environment; staff should take care and manage the classrooms efficiently.

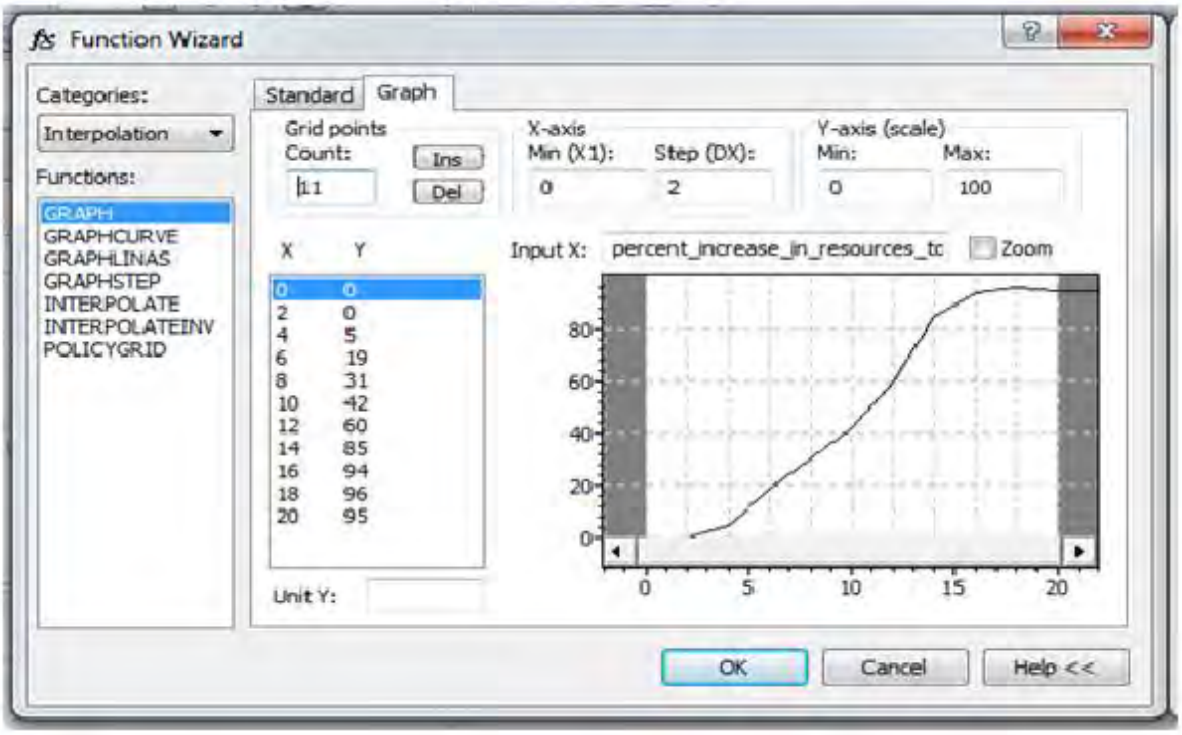


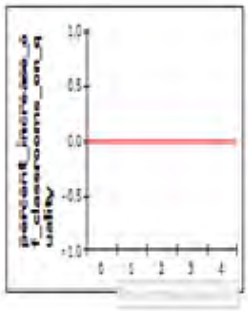
Figure (6-4-h): Educational Resources Factor Effect on Estimated Quality for the Private University; Source: (The Researcher)

The increase in the educational resources leads to an increase in the perceived quality; 10% rise in the provided resources to the students causes 42% rise in the attained quality.

6.2.3.4 Step 4 Structural Validation of the Classrooms Model

6.2.3.4.1 Extreme Conditions (PUBLIC)

Figure (6-4-i) shows that the model was run with zero budget and rational answer of zero was achieved. Total budget: initial value: 3465200, initial quality: 51.65, minimum value: 0, total quality: 0.

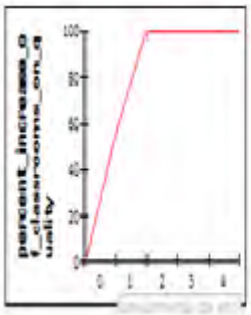


year	effect_of_staff_on_quality	effect_of_maintenance_on_quality	ect_of_resources_on_qua	increase_of_classrooms_on
0	0.00	0.00	0.00	0.00
1	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00

Figure (6-4-i): Extreme Conditions for the Classrooms; Source: (The Researcher)

6.2.3.4.2 Parameter Sensitivity (PUBLIC)

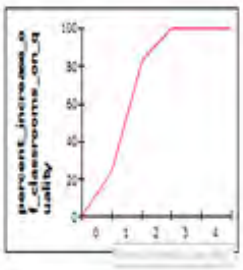
The key parameters were chosen and their values changed slightly. No large changes in Quality were observed which means that the parameters were not sensitive. Typical examples are shown in the figures below. 1-Educational resources: budget initial value: 693040, quality of factor: 55.95, total quality: 51.65, budget maximum value: 3465200, quality of factor: 100, total quality: 100.



year	effect_of_staff_on_quality	effect_of_maintenance_on_quality	ect_of_resources_on_qua	increase_of_classrooms_on
0	0.00	0.00	0.00	0.00
1	0.00	0.00	55.96	55.96
2	0.00	0.00	100.00	100.00
3	0.00	0.00	100.00	100.00
4	0.00	0.00	100.00	100.00
5	0.00	0.00	100.00	100.00

Figure (6-4-j): Parameter Analysis for Educational Resources Factor of Classrooms; Source: (The Researcher)

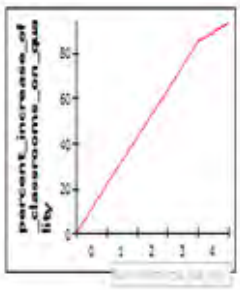
2- Maintenance: budget initial value: 1039560, quality of factor: 45.5, total quality: 51.65, budget maximum value: 3465200, quality of factor: 100, total quality: 100.



year	effect_of_staff_on_quality	effect_of_maintenance_on_quality	ect_of_resources_on_qua	increase_of_classrooms_on
0	0.00	0.00	0.00	0.00
1	0.00	24.58	0.00	24.58
2	0.00	83.26	0.00	83.26
3	0.00	100.00	0.00	100.00
4	0.00	100.00	0.00	100.00
5	0.00	100.00	0.00	100.00

Figure (6-4-k): Parameter Analysis for Maintenance Factor of Classrooms; Source: (The Researcher)

3-Staff: budget initial value: 1732600, quality of factor: 53.5, total quality: 51.65, budget maximum value: 3465200, quality of factor: 93, total quality: 93.

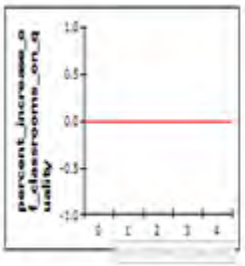


year	effect_of_staff_on_quality	effect_of_maintenance_on_quality	ect_of_resources_on_qua	increase_of_classrooms_on
0	0.00	0.00	0.00	0.00
1	22.36	0.00	0.00	22.36
2	43.68	0.00	0.00	43.68
3	63.79	0.00	0.00	63.79
4	85.66	0.00	0.00	85.66
5	93.30	0.00	0.00	93.30

Figure (6-4-l): Parameter Analysis for Staff Factor of Classrooms; Source: (The Researcher)

6.2.3.4.3 Extreme Conditions (PRIVATE)

Figure (6-4-m) shows that the model was run with zero budget and rational answer of zero was achieved. Total budget: initial value: 3000000, initial quality: 100, minimum value: 0, total quality: 0.



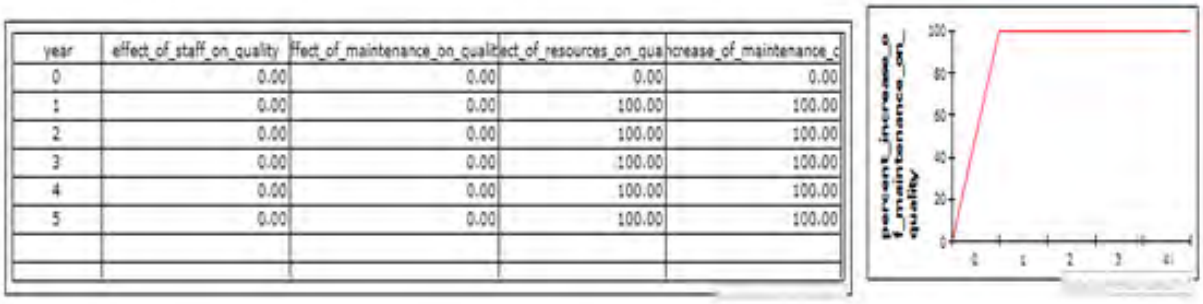
year	effect_of_staff_on_quality	effect_of_maintenance_on_quality	ect_of_resources_on_qua	increase_of_classrooms_on
0	0.00	0.00	0.00	0.00
1	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00

Figure (6-4-m): Extreme Conditions for the Classrooms in the Private University; Source: (The Researcher)

6.2.3.4.4 Parameter Sensitivity (PRIVATE)

The key parameters were chosen and their values changed slightly. No large changes in Quality were observed which means that the parameters were not sensitive. Typical examples are shown in the figures below.

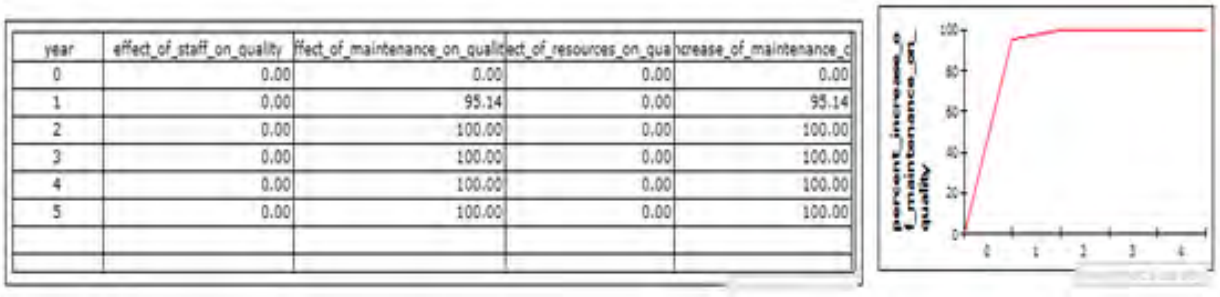
1-Educational resources: budget initial value: 600000, quality of factor: 100, total quality: 100, budget maximum value: 3000000, quality of factor: 100, total quality: 100.



year	effect_of_staff_on_quality	ffect_of_maintenance_on_qualit	ect_of_resources_on_qua	crease_of_maintenance_c
0	0.00	0.00	0.00	0.00
1	0.00	0.00	100.00	100.00
2	0.00	0.00	100.00	100.00
3	0.00	0.00	100.00	100.00
4	0.00	0.00	100.00	100.00
5	0.00	0.00	100.00	100.00

Figure (6-4-n): Parameter Analysis for Educational Resources Factor of Classrooms in the Private University; Source: (The Researcher)

2- Maintenance: budget initial value: 900000, quality of factor: 100, total quality: 100, budget maximum value: 3000000, quality of factor: 100, total quality: 100.



year	effect_of_staff_on_quality	ffect_of_maintenance_on_qualit	ect_of_resources_on_qua	crease_of_maintenance_c
0	0.00	0.00	0.00	0.00
1	0.00	95.14	0.00	95.14
2	0.00	100.00	0.00	100.00
3	0.00	100.00	0.00	100.00
4	0.00	100.00	0.00	100.00
5	0.00	100.00	0.00	100.00

Figure (6-4-o): Parameter Analysis for Maintenance Factor of Classrooms in the Private University; Source: (The Researcher)

3-Staff: budget initial value: 150000, quality of factor: 100, total quality: 100, budget maximum value: 3000000, quality of factor: 100, total quality: 100.

year	effect_of_staff_on_quality	ffect_of_maintenance_on_qualit	ect_of_resources_on_qua	ncrease_of_maintenance_o
0	0.00	0.00	0.00	0.00
1	59.82	0.00	0.00	59.82
2	100.00	0.00	0.00	100.00
3	100.00	0.00	0.00	100.00
4	100.00	0.00	0.00	100.00
5	100.00	0.00	0.00	100.00

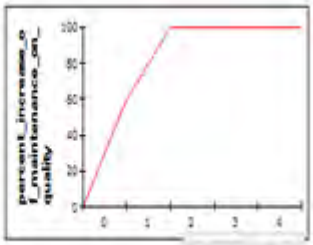


Figure (6-4-p): Parameter Analysis for Staff Factor of Classrooms in the Private University; Source: (The Researcher)

6.2.4 SPORTS

6.2.4.1 Step 1 Creating the Causal Model for Sports

Figure (6-5-a) shows the causal model for the sports facility. Sports budget represents the amount spent on purchasing and maintaining of sports tools, and paying salaries to skilled sports trainers. The higher the budget spent the better the quality of sports activities attained, leading to an increase in the number of students subscribing to and using these activities. Over time, the increasing number of students will affect the quality of service, as the capacity of playing courts will decrease in comparison to the students-trainers ratio, which will produce a decrease in the total quality of service.

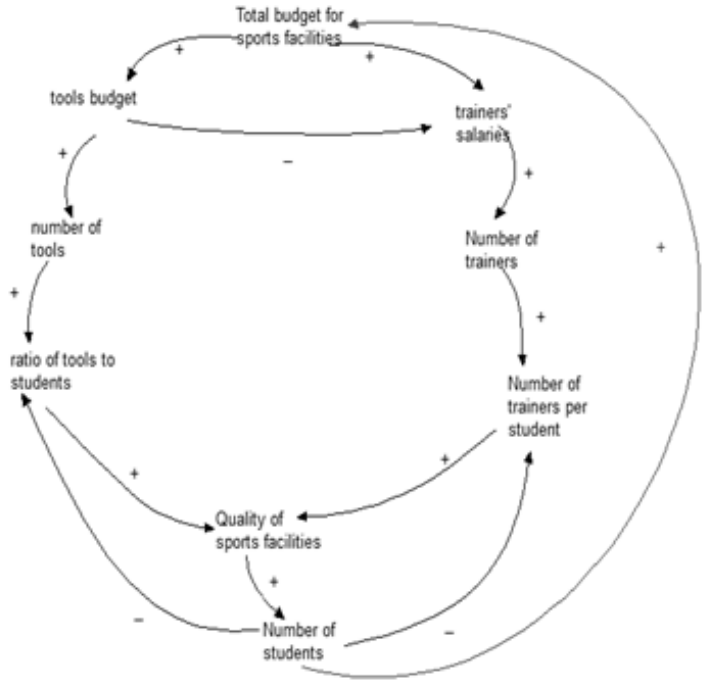


Figure (6-5-a): Sports Causal Model; Source: (The Researcher)

6.2.4.2 Step 2 Creating System Dynamics Model for Sports

Figure (6-5-b) shows the stock & flow of sports facility then the proceeding figures express sequentially the resulting quality for this service and the obtained graphs for the factors that establish the facility. The sports activities facility depends heavily on the availability of tools and space for different types of sports like tennis court, swimming pools, football courts, basketballs, and so on. The effect of trainers is almost zero as that the most common played sport is football then comes the basketball where the Egyptian culture is a bit conservative especially in public universities and the majority of males not females are the ones who use these games. The assumed relationship has no effect on the quality although it is positive relation. Accordingly, the percentage of increase in trainers is negative as public universities do not hire trainers. Then the provision of sports tools will help increasing the quality of sports activities facility. The model equations are given in the Appendix E.

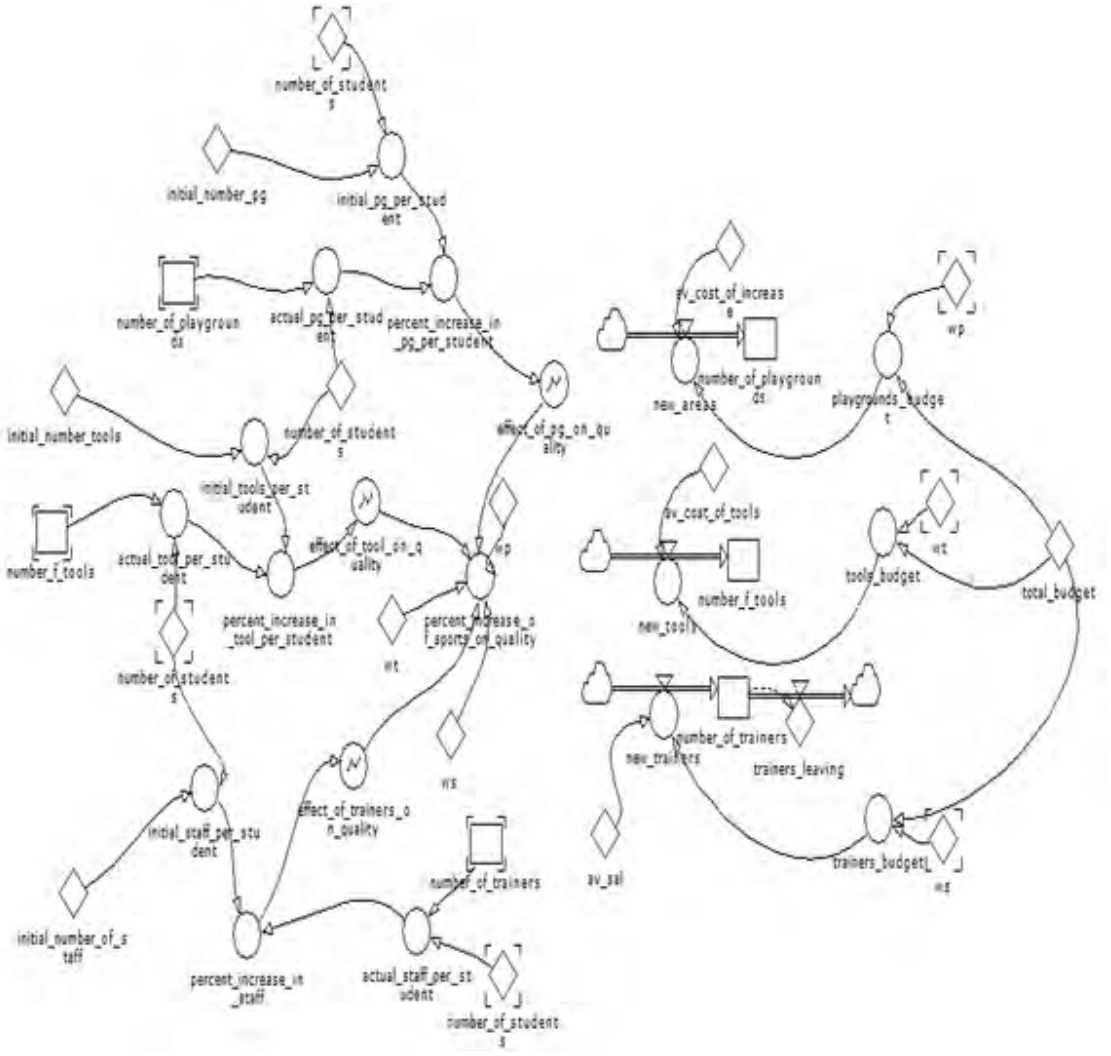


Figure (6-5-b): Sports Stock & Flow Diagram; Source: (The Researcher)

6.2.4.3 Step 3a Table Functions Used for Sports for PUBLIC University

Figure (6-5-c), figure (6-5-d), and figure (6-5-e) demonstrate the effect of each factor on the estimated quality contributing to the Sports facility service. The evidence for the proceeding graph functions was derived from the facility manager interview given in the Appendix D.

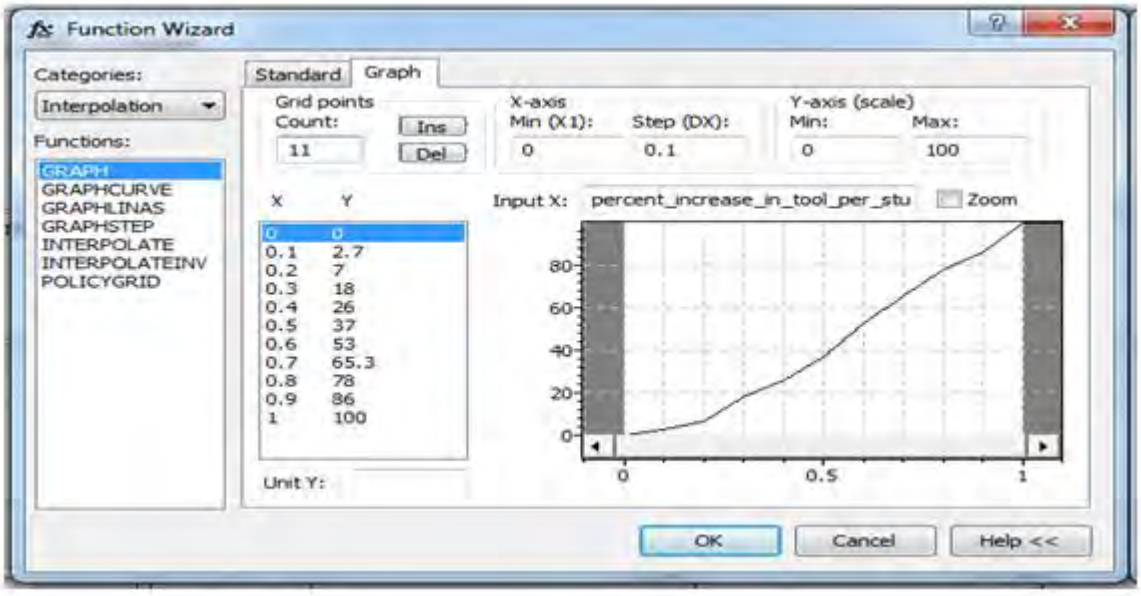


Figure (6-5-c): Tools Factor Effect on Estimated Quality; Source: (The Researcher)

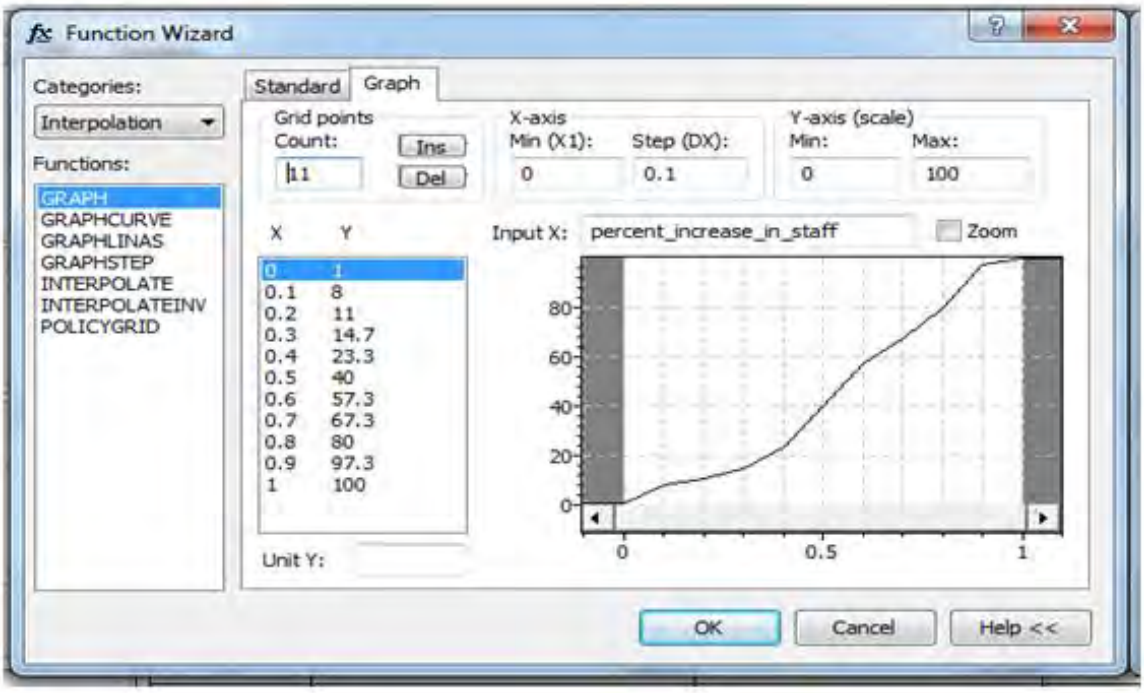


Figure (6-5-d): Staff Factor Effect on Estimated Quality; Source: (The Researcher)

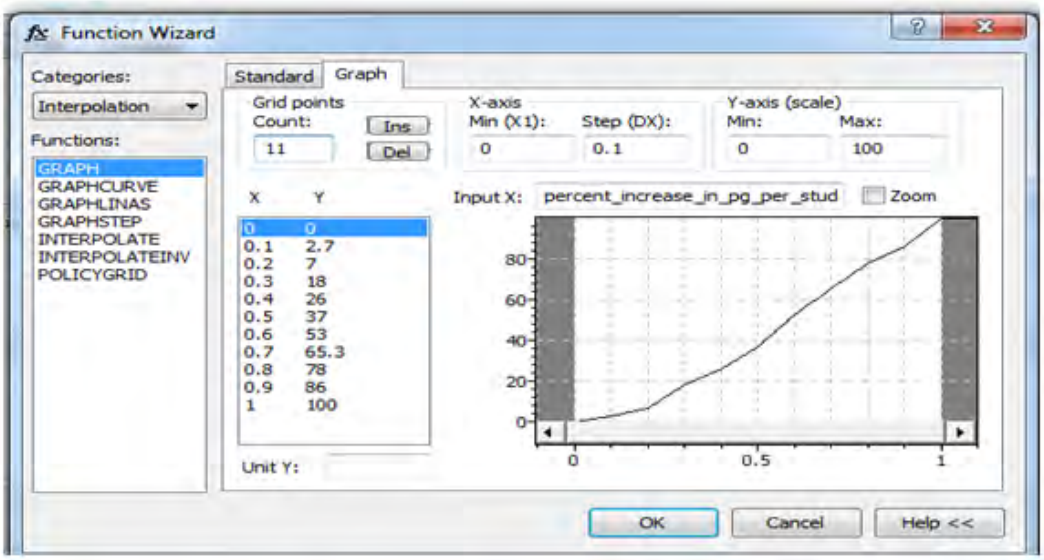


Figure (6-5-e): Playgrounds Factor Effect on Estimated Quality; Source: (The Researcher)

Over time, the quality of sports activities facility will remain constant, though the amount of budget increases and the value added also will be turning negatively. While the number of students rises, yet the resources available are constant and over saturated can not obtain more over capacity.

6.2.4.3 Step 3b Table Functions Used for Sports for PRIVATE University

For each sport type, tools must be sufficiently enough to cover the maximum number of players. As tools increase and regularly being up-to-date, quality increases.

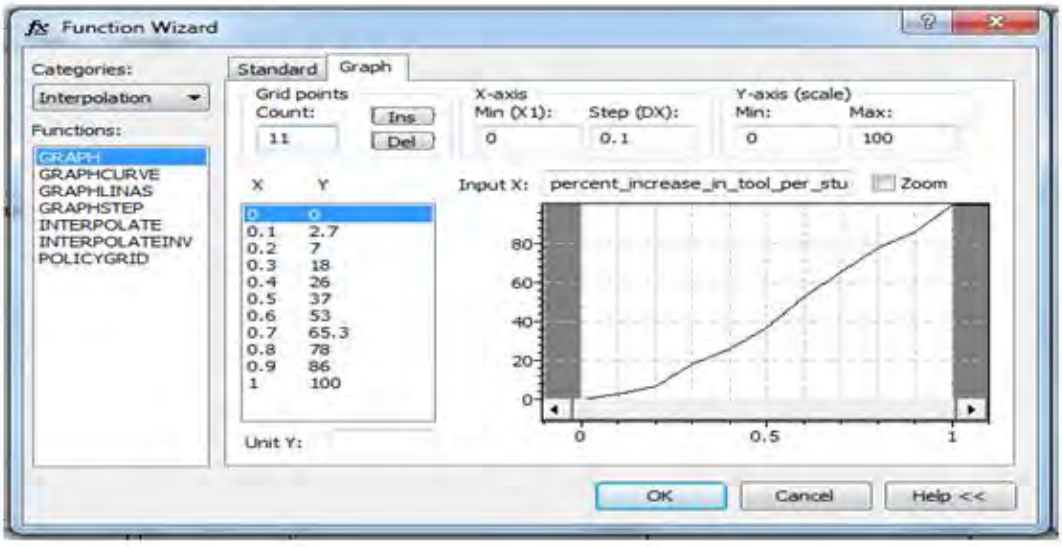


Figure (6-5-f): Tools Factor Effect on Estimated Quality for the Private University; Source: (The Researcher)

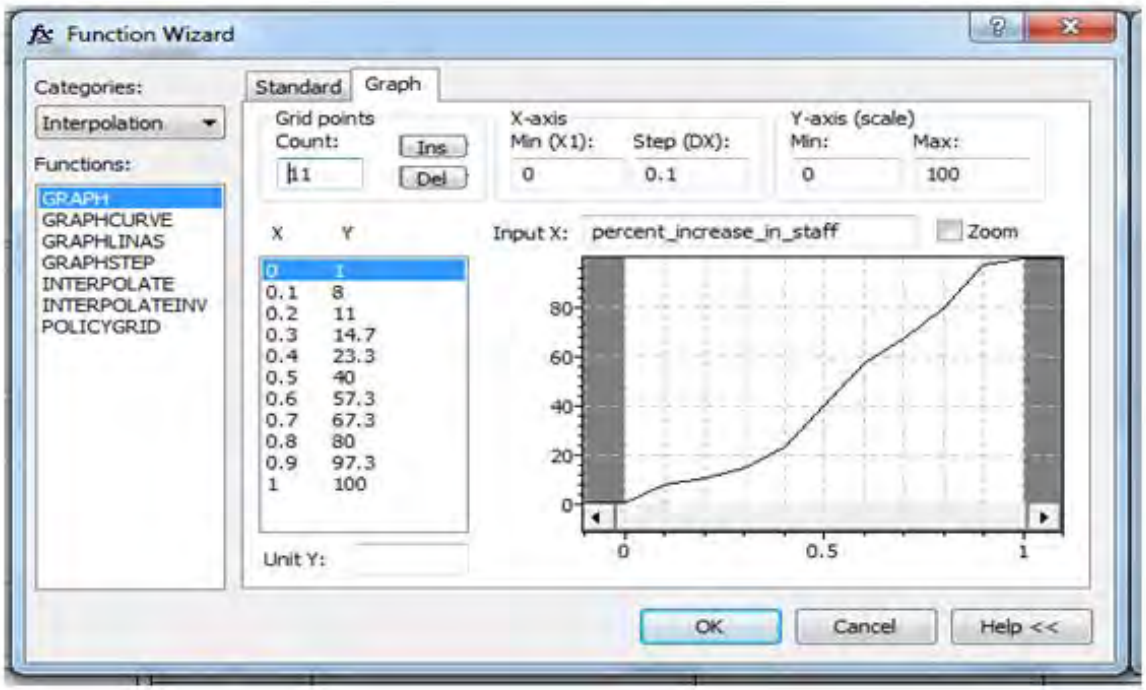


Figure (6-5-g): Staff Factor Effect on Estimated Quality for the Private University; Source: (The Researcher)

No doubt that trainers are essential for a productive sport activity. As number of trainers in relevance to students increases, the quality of sports becomes higher.

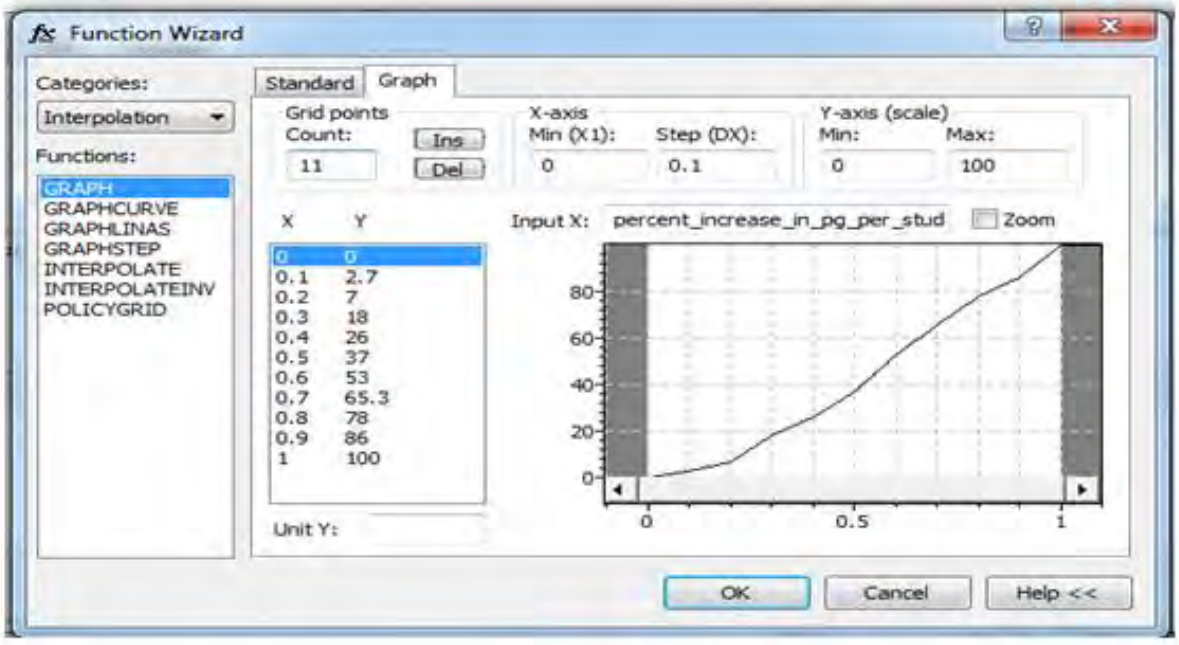


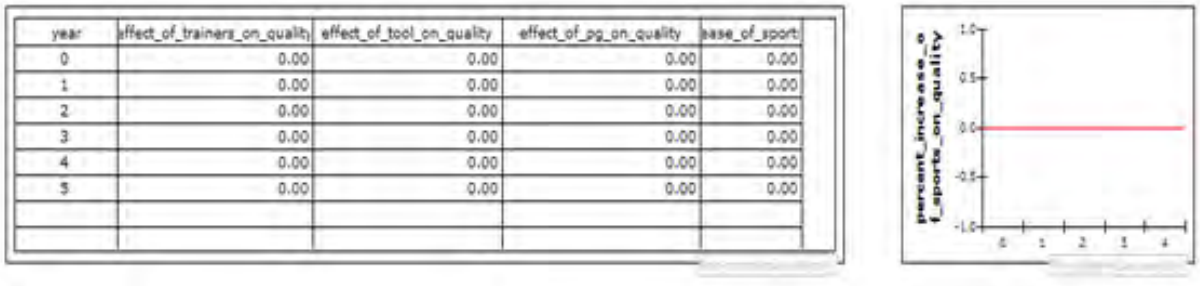
Figure (6-5-h): Playgrounds Factor Effect on Estimated Quality for the Private University; Source: (The Researcher)

With the increase of number of students enrolling to the university, more playgrounds would be needed to maintain better quality of the service facility. As the percentage of playgrounds/students increases, quality increases.

6.2.4.4 Step 4 Structural Validation of the Sports Model

6.2.4.4.1 Extreme Conditions (PUBLIC)

Figure (6-5-i) shows that the model was run with zero budgets and sensible answer of zero was obtained. Total budget: initial value: 140000, initial quality: 66.25, minimum value: 0, total quality: 0.



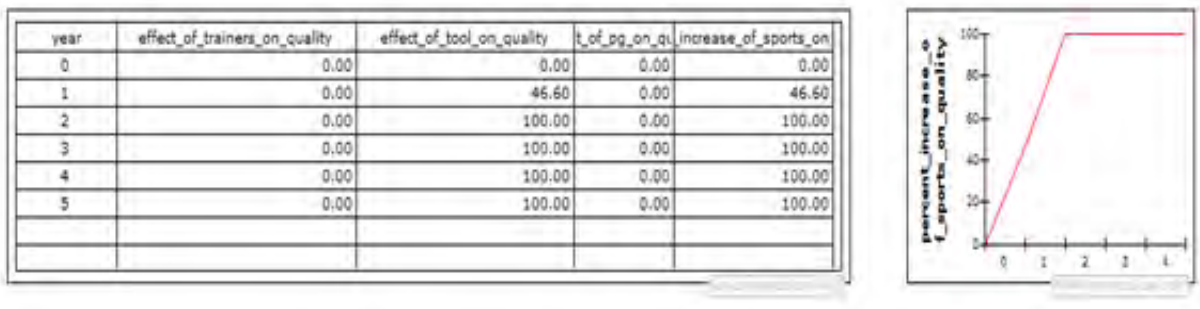
year	effect_of_trainers_on_quality	effect_of_tool_on_quality	effect_of_pg_on_quality	base_of_sport
0	0.00	0.00	0.00	0.00
1	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00

Figure (6-5-i): Extreme Conditions for Sports; Source: (The Researcher)

6.2.4.4.2 Parameter Sensitivity (PUBLIC)

The key parameters were chosen and their values changed slightly. No large changes in Quality were observed which means that the parameters were not sensitive. Typical examples are shown in the figures below.

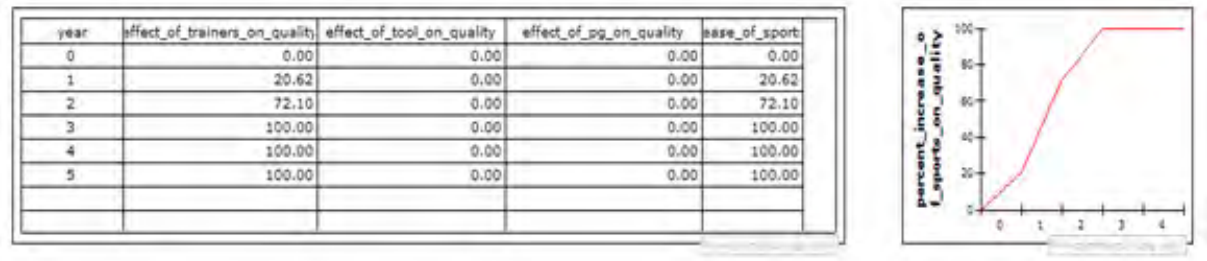
1-Tools: budget initial value: 42000, quality of factor: 81.2, total quality: 66.2, budget maximum value: 140000, quality of factor: 100, total quality: 100.



year	effect_of_trainers_on_quality	effect_of_tool_on_quality	t_of_pg_on_qu	increase_of_sports_on
0	0.00	0.00	0.00	0.00
1	0.00	46.60	0.00	46.60
2	0.00	100.00	0.00	100.00
3	0.00	100.00	0.00	100.00
4	0.00	100.00	0.00	100.00
5	0.00	100.00	0.00	100.00

Figure (6-5-j): Parameter Analysis for Tools Factor of Sports; Source: (The Researcher)

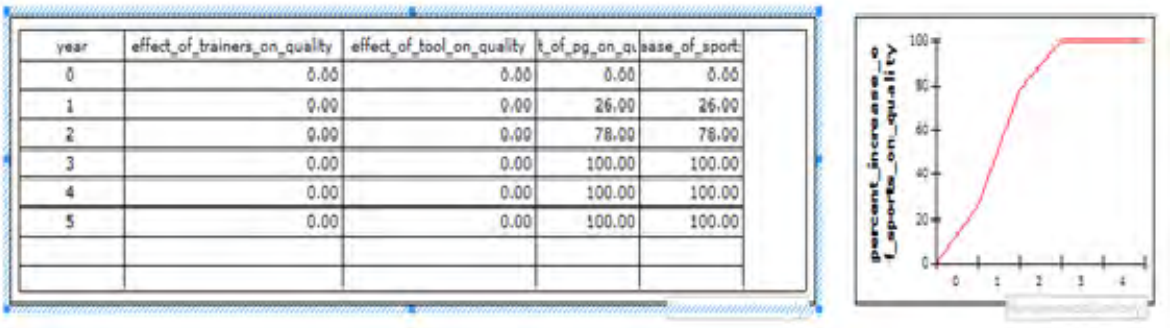
2-Staff (Trainers): budget initial value: 56000, quality of factor: 65, total quality: 66.2, budget maximum value: 140000, quality of factor: 100, total quality: 100.



year	effect_of_trainers_on_quality	effect_of_tool_on_quality	effect_of_pg_on_quality	ease_of_sport
0	0.00	0.00	0.00	0.00
1	20.62	0.00	0.00	20.62
2	72.10	0.00	0.00	72.10
3	100.00	0.00	0.00	100.00
4	100.00	0.00	0.00	100.00
5	100.00	0.00	0.00	100.00

Figure (6-5-k): Parameter Analysis for Staff Factor of Sports; Source: (The Researcher)

3-Playgrounds: budget initial value: 42000, quality of factor: 53, total quality: 66.2, budget maximum value: 140000, quality of factor: 85.19, total quality: 85.1.

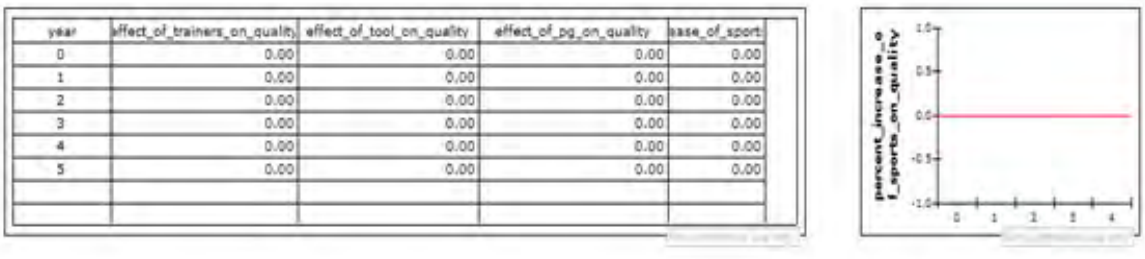


year	effect_of_trainers_on_quality	effect_of_tool_on_quality	t_of_pg_on_qu	ease_of_sport
0	0.00	0.00	0.00	0.00
1	0.00	0.00	26.00	26.00
2	0.00	0.00	78.00	78.00
3	0.00	0.00	100.00	100.00
4	0.00	0.00	100.00	100.00
5	0.00	0.00	100.00	100.00

Figure (6-5-l): Parameter Analysis for Playgrounds Factor of Sports; Source: (The Researcher)

6.2.4.4.3 Extreme Conditions (PRIVATE)

Figure (6-5-m) shows that the model was run with zero budget and logical answer of zero was acquired. Total budget: initial value: 630000, initial quality: 88.37, minimum value: 0, total quality: 0.



year	effect_of_trainers_on_quality	effect_of_tool_on_quality	effect_of_pg_on_quality	ease_of_sport
0	0.00	0.00	0.00	0.00
1	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00

Figure (6-5-m): Extreme Conditions for Sports in the Private University; Source: (The Researcher)

6.2.4.4.4 Parameter Sensitivity (PRIVATE)

The key parameters of the sports were chosen and no massive changes were caused as shown in the following figures.

1-Tools: budget initial value: 42000, quality of factor: 86, total quality: 88.36, budget maximum value: 630000, quality of factor: 100, total quality: 100.

year	effect_of_trainers_on_quality	effect_of_tool_on_quality	effect_of_pg_on_quality	ase_of_sport
0	0.00	0.00	0.00	0.00
1	0.00	22.80	0.00	22.80
2	0.00	67.84	0.00	67.84
3	0.00	100.00	0.00	100.00
4	0.00	100.00	0.00	100.00
5	0.00	100.00	0.00	100.00

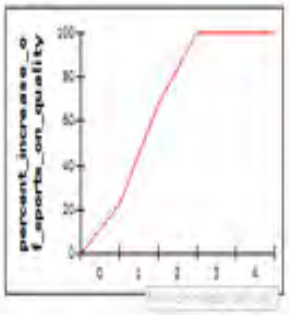


Figure (6-5-n): Parameter Analysis for Tools Factor of Sports in the Private University; Source: (The Researcher)

2-Staff (Trainers): budget initial value: 56000, quality of factor: 76.82, total quality: 88.36, budget maximum value: 630000, quality of factor: 100, total quality: 100.

year	effect_of_trainers_on_quality	effect_of_tool_on_quality	effect_of_pg_on_quality	ase_of_sport
0	0.00	0.00	0.00	0.00
1	89.52	0.00	0.00	89.52
2	100.00	0.00	0.00	100.00
3	100.00	0.00	0.00	100.00
4	100.00	0.00	0.00	100.00
5	100.00	0.00	0.00	100.00

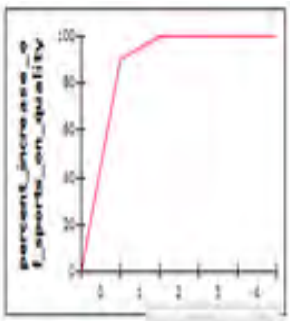


Figure (6-5-o): Parameter Analysis for Staff Factor of Sports in the Private University; Source: (The Researcher)

3-Playgrounds: budget initial value: 189000, quality of factor: 100, total quality: 88.36, budget maximum value: 630000, quality of factor: 100, total quality: 100.

year	effect_of_trainers_on_quality	effect_of_tool_on_quality	effect_of_pg_on_quality	ease_of_sport
0	0.00	0.00	0.00	0.00
1	0.00	0.00	65.30	65.30
2	0.00	0.00	100.00	100.00
3	0.00	0.00	100.00	100.00
4	0.00	0.00	100.00	100.00
5	0.00	0.00	100.00	100.00

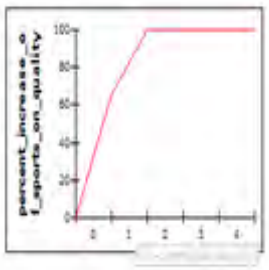


Figure (6-5-p): Parameter Analysis for Playgrounds Factor of Sports in the Private University; Source: (The Researcher)

6.2.5 HEALTH CARE

6.2.5.1 Step 1 Creating the Causal Model for Health Care

Health care service considered one of the most key service facilities in educational institution. Health care budget is spent on medical staff salaries and purchasing medicines. The higher the budget the better the quality of service as it is a positive relationship. However, if the number of students increases, the probability of their usage to the health services will be higher too which might affect the quality because the amount of medicine available and the working staff won‟t be enough to cover the students‟ needs. It is a negative relationship. The health service causal model is shown in Figure (6-6-a) below.

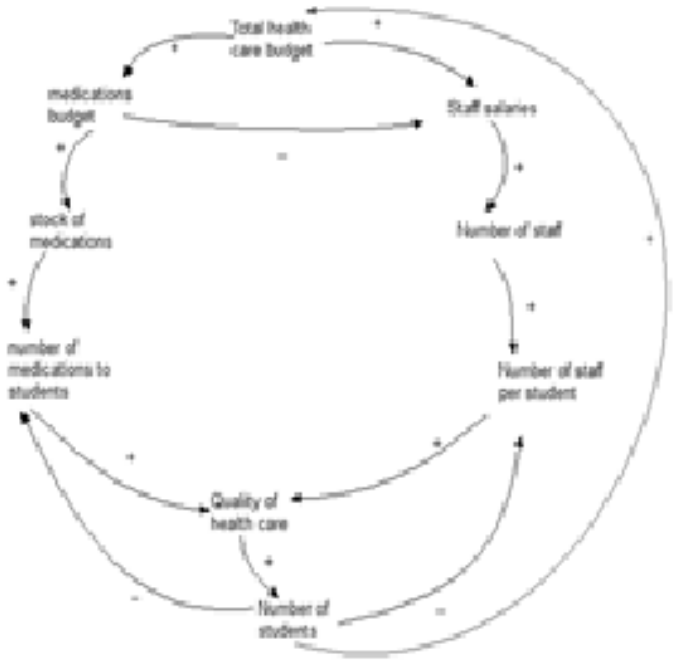


Figure (6-6-a): Health Care Causal Model; Source: (The Researcher)

6.2.5.2 Step 2 Creating System Dynamics for Health Care

The stock & flow diagram is displayed in the subsequent figure (6-6-b) and the resultant effect on the estimated quality of each constructed factor is later demonstrated in the proceeding figures. The model equations are displayed in the Appendix E.

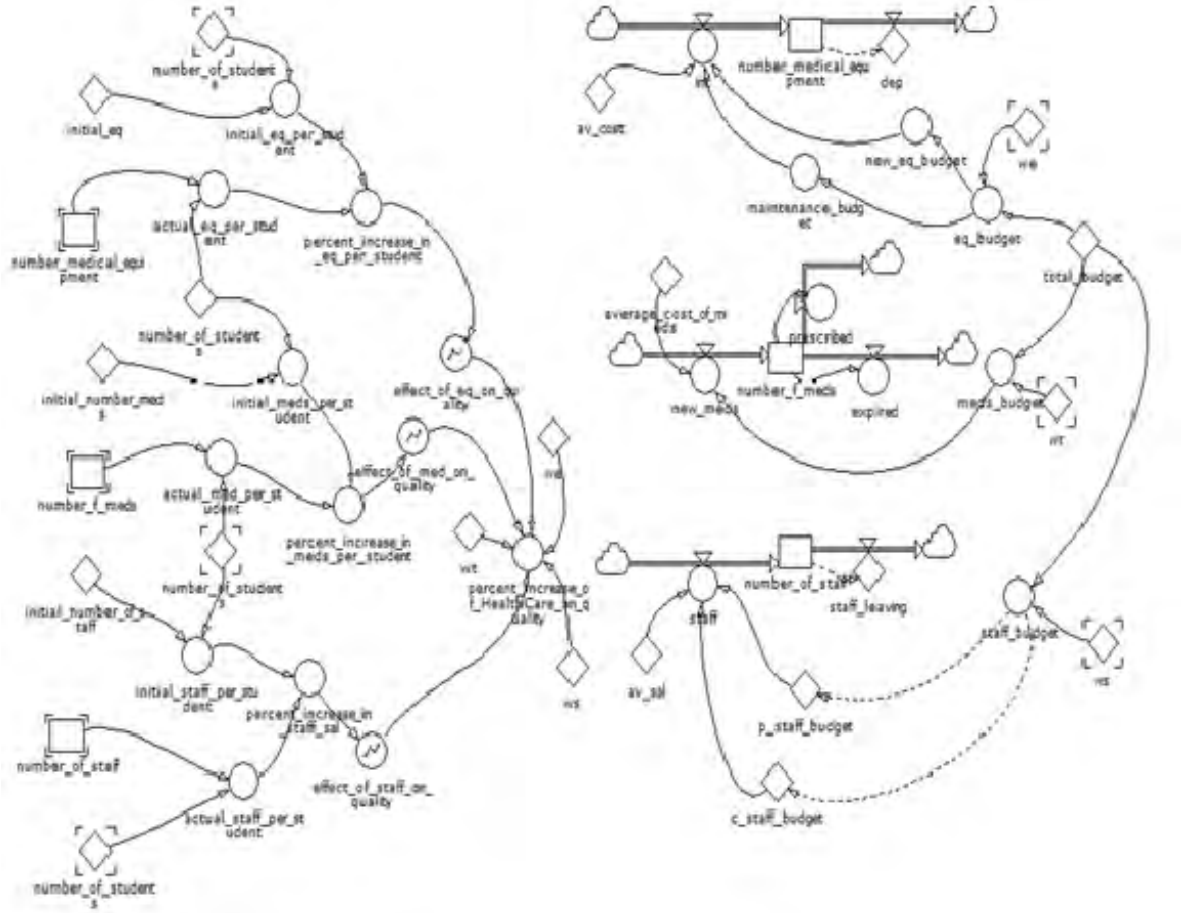


Figure (6-6-b): Health Care Stock & Flow Diagram; Source: (The Researcher)

6.2.5.3 Step 3a Table Functions Used for Health Care for PUBLIC University

The Health Care Services in public universities rely on the availability of medication and the practitioners and doctors responsiveness. Although, the presence of the staff is important and has a positive influence, nevertheless not remarkably as the students who are suffering from severe conditions are sent to be treated in governmental hospitals. Taking into consideration that all specializations are accessible but the number of occurrence of dentists is only one in each campus and additionally sometimes, certain cases could be directed to external clinics. The medication is given freely to students as they are by default subscribed in health medical

insurance. The percentage increase in equipment per student will positively affect the quality of service. The medication and equipment are viewed as the most significant elements affecting the estimated quality of Health Care, which is usually used by students on daily basis.

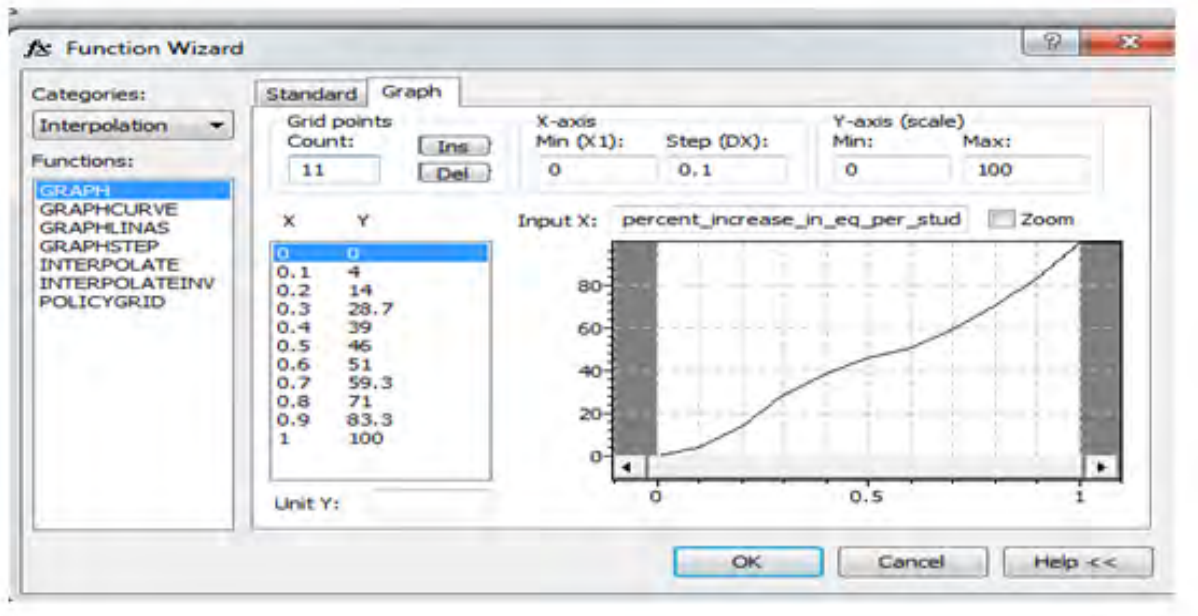


Figure (6-6-c): Equipment Factor Effect on Estimated Quality; Source: (The Researcher)

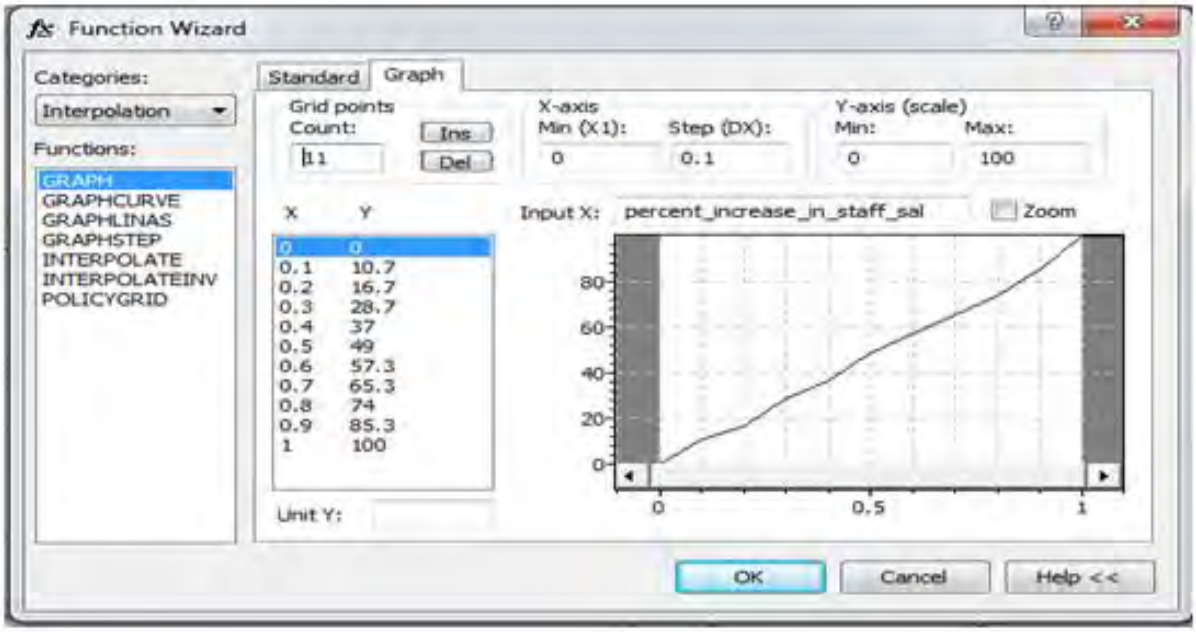


Figure (6-6-d): Staff Factor Effect on Estimated Quality; Source: (The Researcher)

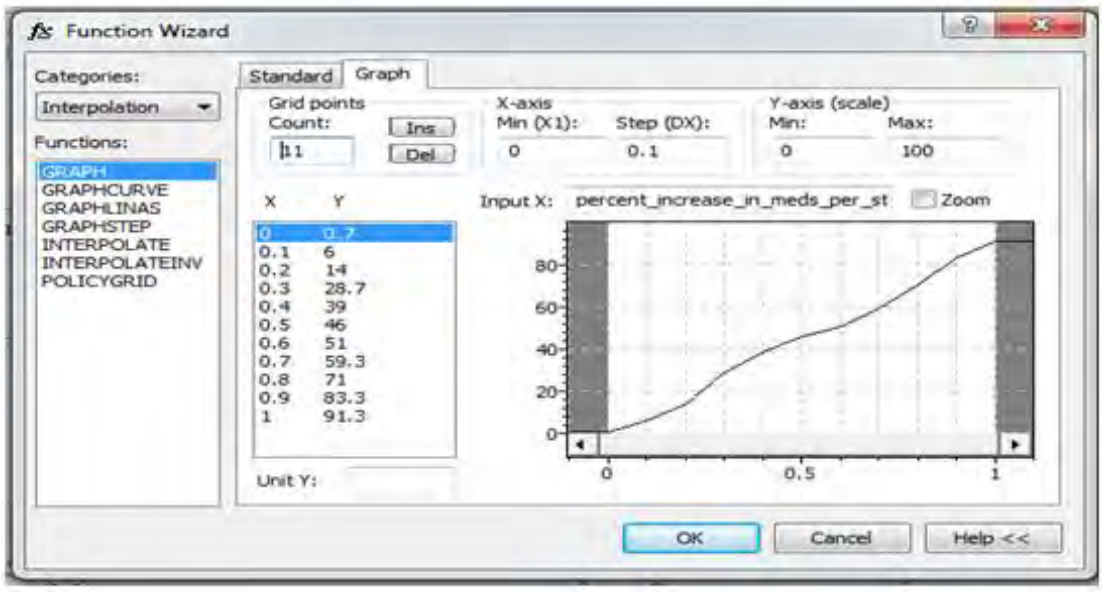


Figure (6-6-e): Medication Factor Effect on Estimated Quality; Source: (The Researcher)

6.2.5.3 Step 3b Table Functions Used for Health Care for PRIVATE University

The next figures show the effect on the estimated quality of each contributing factor to the Health Care service facility. Equipment of health care affect the quality directly; through the increase of the equipment, the service provided to the students is improved and hence a better quality is attained. 0.5% increase in number of equipment in accordance to students results in 67% increase in quality of the service facility.

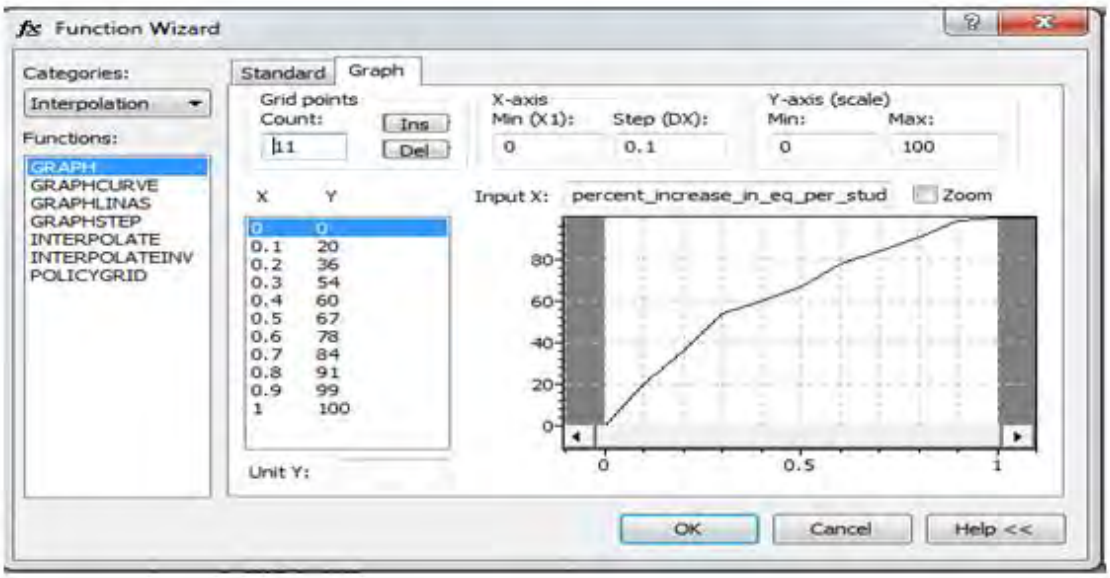


Figure (6-6-f): Equipment Factor Effect on Estimated Quality for the Private University; Source: (The Researcher)

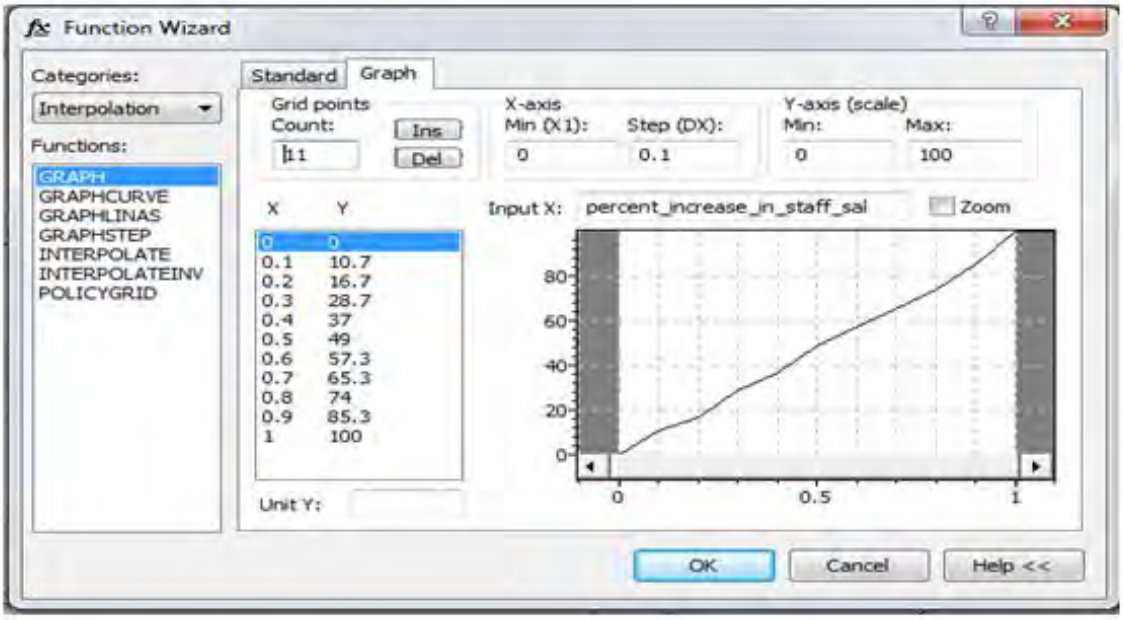


Figure (6-6-g): Staff Factor Effect on Estimated Quality for the Private University; Source: (The Researcher)

Number of staff of health care facility in the university is not enough compared to number of students. Quality could increase by increasing number of staff till it reaches a 100% increase for a 1% increase in percent of staff/students.

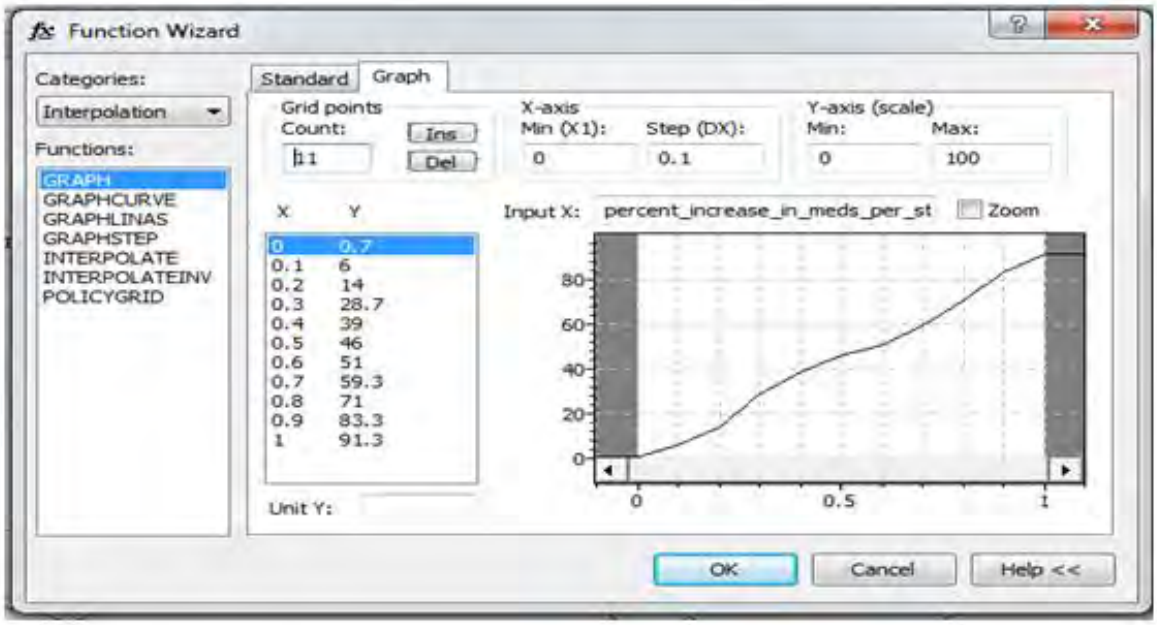


Figure (6-6-h): Medications Factor Effect on Estimated Quality for the Private University; Source: (The Researcher)

Quality of the health care service facility is affected by the availability of medications in regards to number of students.

6.2.5.4 Step 4 Structural Validation of the HEALTH CARE Model

6.2.5.4.1 Extreme Conditions (PUBLIC)

Figure (6-6-i) demonstrates that the model was run with zero budget and sensible answer of zero was obtained. Total budget: initial value: 464000, initial quality: 17.2, minimum value: 0, total quality: 0

year	effect_of_med_on_quality	effect_of_staff_on_quality	effect_of_eq_on_quality	e_of_HealthC
0	0.00	0.00	0.00	0.00
1	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00

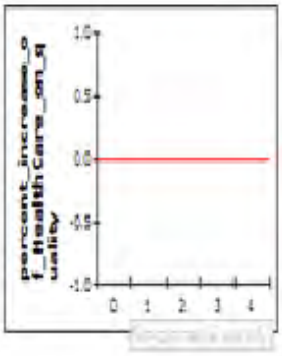


Figure (6-6-i): Extreme Conditions for Health Care; Source: (The Researcher)

6.2.5.4.2 Parameter Sensitivity (PUBLIC)

The key parameters of the Health Care were chosen and their values changed slightly. No large changes in Quality were noticed. Typical examples are revealed in figures below.

1-Equipment: budget initial value: 92000, quality of factor: 0, total quality: 17.2, budget maximum value: 464000, quality of factor: 35.29, total quality: 35.29.

year	effect_of_med_on_quality	effect_of_staff_on_quality	effect_of_eq_on_quality	increase_of_HealthCare_or
0	0.70	0.00	0.00	0.00
1	0.70	0.00	2.91	2.91
2	0.70	0.00	8.56	8.56
3	0.70	0.00	16.70	16.70
4	0.70	0.00	27.41	27.41
5	0.70	0.00	35.29	35.29

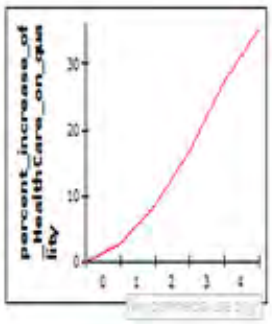
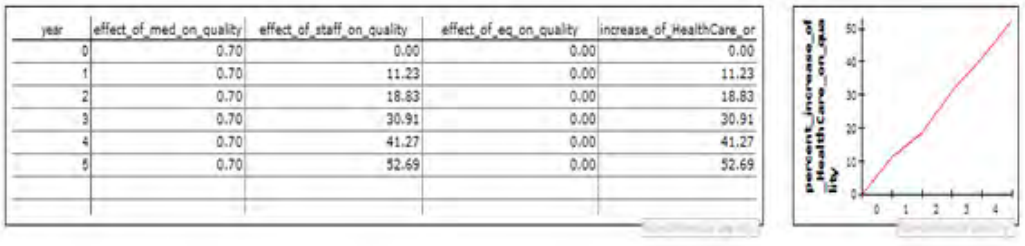


Figure (6-6-j): Parameter Analysis for Equipment Factor of Health Care in the Public University; Source: (The Researcher)

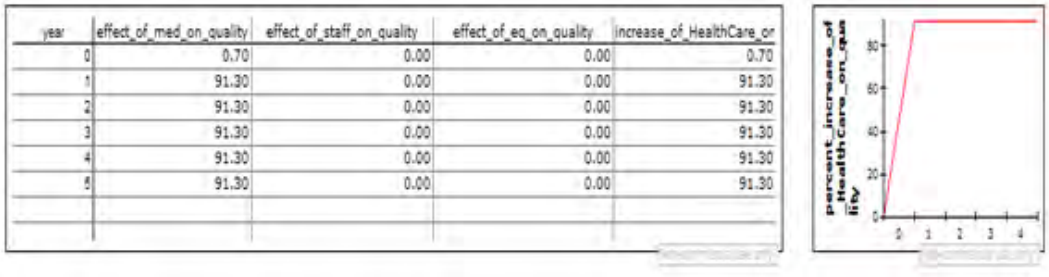
2-Staff: budget initial value: 185600, quality of factor: 28.9 total quality: 17.2, budget maximum value: 464000, quality of factor: 52.69, total quality: 52.69.



year	effect_of_med_on_quality	effect_of_staff_on_quality	effect_of_eq_on_quality	increase_of_HealthCare_or
0	0.70	0.00	0.00	0.00
1	0.70	11.23	0.00	11.23
2	0.70	18.83	0.00	18.83
3	0.70	30.91	0.00	30.91
4	0.70	41.27	0.00	41.27
5	0.70	52.69	0.00	52.69

Figure (6-6-k): Parameter Analysis for Staff Factor of Health Care; Source: (The Researcher)

3-Medication: budget initial value: 185600, quality of factor: 28.9, total quality: 17.2, budget maximum value: 464000, quality of factor: 91.3, total quality: 91.3.

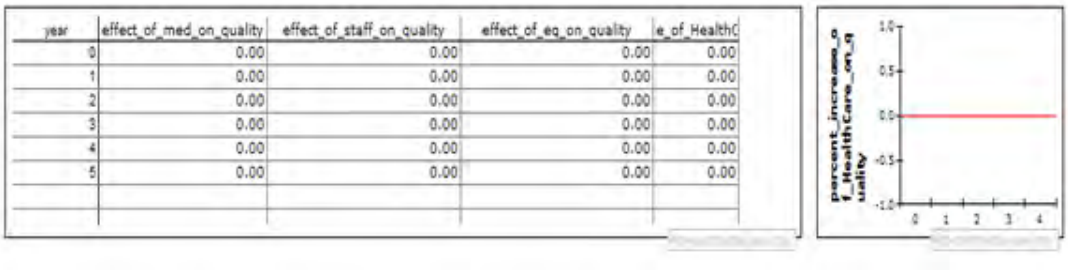


year	effect_of_med_on_quality	effect_of_staff_on_quality	effect_of_eq_on_quality	increase_of_HealthCare_or
0	0.70	0.00	0.00	0.70
1	91.30	0.00	0.00	91.30
2	91.30	0.00	0.00	91.30
3	91.30	0.00	0.00	91.30
4	91.30	0.00	0.00	91.30
5	91.30	0.00	0.00	91.30

Figure (6-6-l): Parameter Analysis for Medication Factor of Health Care; Source: (The Researcher)

6.2.5.4.3 Extreme Conditions (PRIVATE)

Figure (6-6-m) illustrates that the model was run with zero budget and rational answer of zero was obtained. Total budget: initial value: 500000, initial quality: 88.37, minimum value: 0, total quality: 0.



year	effect_of_med_on_quality	effect_of_staff_on_quality	effect_of_eq_on_quality	e_of_HealthC
0	0.00	0.00	0.00	0.00
1	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00

Figure (6-6-m): Extreme Conditions for Health Care in the Private University; Source: (The Researcher)

6.2.5.4.4 Parameter Sensitivity (PRIVATE)

The key parameters were chosen and their values changed slightly. No large changes in Quality were noticed. Typical examples are as shown in next figures.

1-Equipment: budget initial value: 100000, quality of factor: 1.74, total quality: 43.3, budget maximum value: 500000, quality of factor 52.19, total quality: 52.19.

year	effect_of_med_on_quality	effect_of_staff_on_quality	effect_of_eq_on_quality	e_of_HealthC
0	0.00	0.00	0.00	0.00
1	0.00	0.00	6.29	6.29
2	0.00	0.00	20.72	20.72
3	0.00	0.00	35.76	35.76
4	0.00	0.00	45.40	45.40
5	0.00	0.00	52.19	52.19

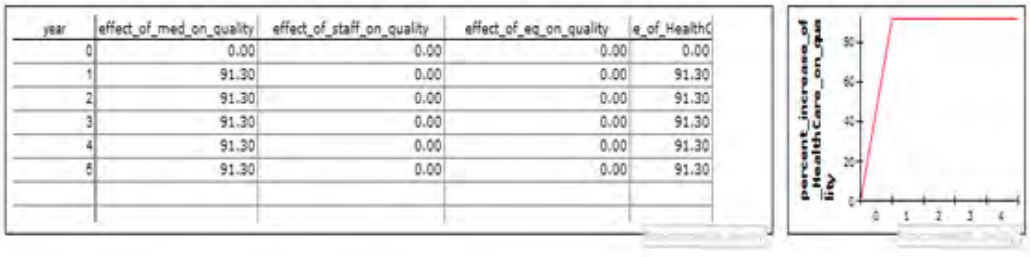
Figure (6-6-n): Parameter Analysis for Equipment Factor of Health Care in the Private University; Source: (The Researcher)

2-Staff: budget initial value: 200000, quality of factor: 30, total quality: 43.3, budget maximum value: 500000, quality of factor: 91.43, total quality: 91.43.

year	effect_of_med_on_quality	effect_of_staff_on_quality	effect_of_eq_on_quality	e_of_HealthC
0	0.00	0.00	0.00	0.00
1	0.00	16.00	0.00	16.00
2	0.00	35.06	0.00	35.06
3	0.00	54.40	0.00	54.40
4	0.00	69.94	0.00	69.94
5	0.00	91.43	0.00	91.43

Figure (6-6-o): Parameter Analysis for Staff Factor of Health Care in the Private University; Source: (The Researcher)

3-Medication: budget initial value: 200000, quality of factor: 77.3, total quality: 43.3, budget maximum value: 500000, quality of factor: 91.3, total quality: 91.3.



year	effect_of_med_on_quality	effect_of_staff_on_quality	effect_of_eq_on_quality	e_of_HealthC
0	0.00	0.00	0.00	0.00
1	91.30	0.00	0.00	91.30
2	91.30	0.00	0.00	91.30
3	91.30	0.00	0.00	91.30
4	91.30	0.00	0.00	91.30
5	91.30	0.00	0.00	91.30

Figure (6-6-p): Parameter Analysis for Medication Factor of Health Care in the Private University; Source: (The Researcher)

6.2.6 EXTRA FACILITIES

6.2.6.1 Step 1 Creating the Causal Model for Extra Facilities

Figure (6-7-a) shows the causal model of extra facilities. The service budget is represented in the expenses spent on safety equipment such as fire extinguishers and smoke alarms, maintaining the premises and landscapes, and security provision through hiring more security guards to protect the university and the students. Expenditure on these facilities will theoretically affect the quality of extra facilities positively as it is a directly proportional relationship between these facilities and the perceived quality. However, over time, the increasing number of students will negatively affect the quality of services if the total budget remains constant.

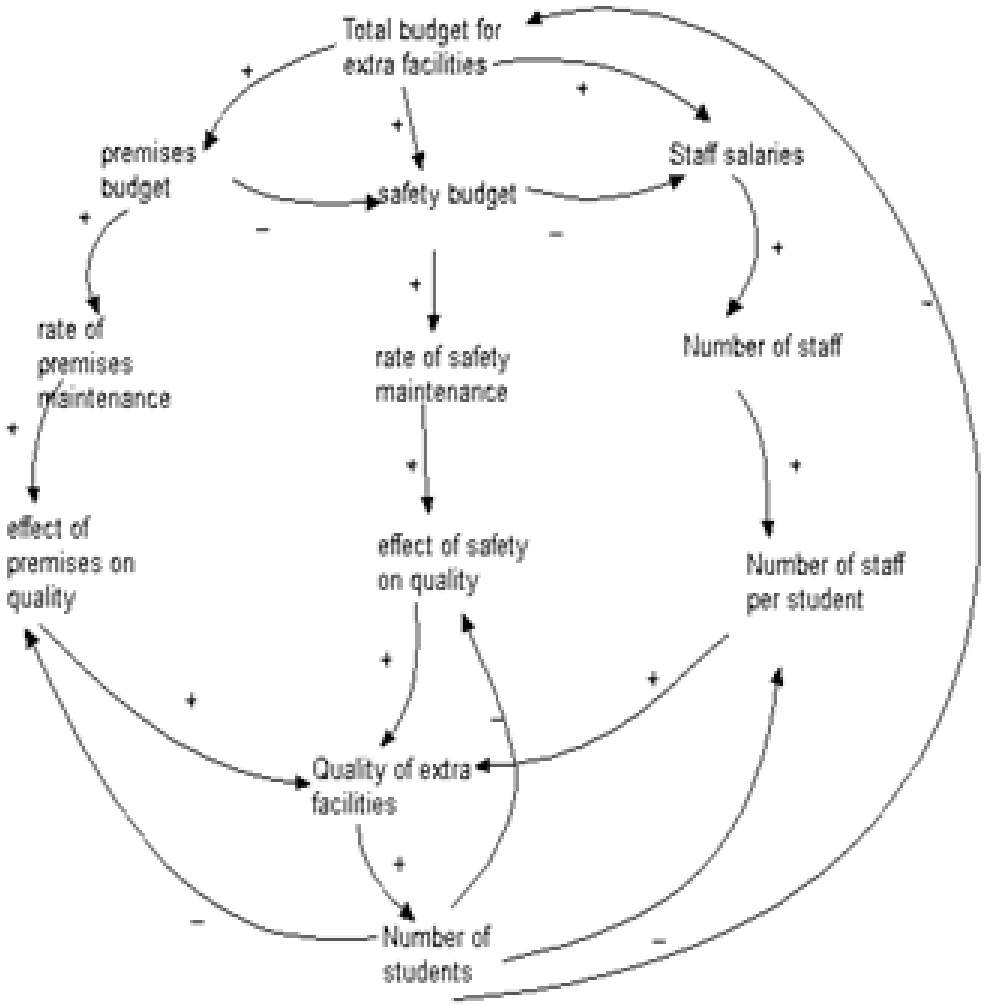


Figure (6-7-a): Extra Facilities Causal Model; Source: (The Researcher)

6.2.6.2 Step 2 Creating System Dynamics Model for Extra Facilities

In the extra facilities System Dynamics model, the total budget used for the composed factors is denoted through the rate of maintenance of safety equipment and the premises, in addition to the number of security staff. The safety budget depends on the average cost of maintenance and the rate by which it is maintained. Likewise, the premises budget is determined by the rate of maintenance and the average cost of maintenance of the landscapes. The security budget fundamentally involves the number of staff and their salary average. If the budget of any of these factors increases, the budget for the other two accordingly decreases. As well, the number of students is a significant factor that affects quality, as the perceived quality is estimated by the sum of ratios of each facility factor per student multiplied to the predefined benchmarking value used. The stock & flow Diagram is defined in Figure (6-7-b) below then the estimated quality for these extra facilities is given subsequent figures.

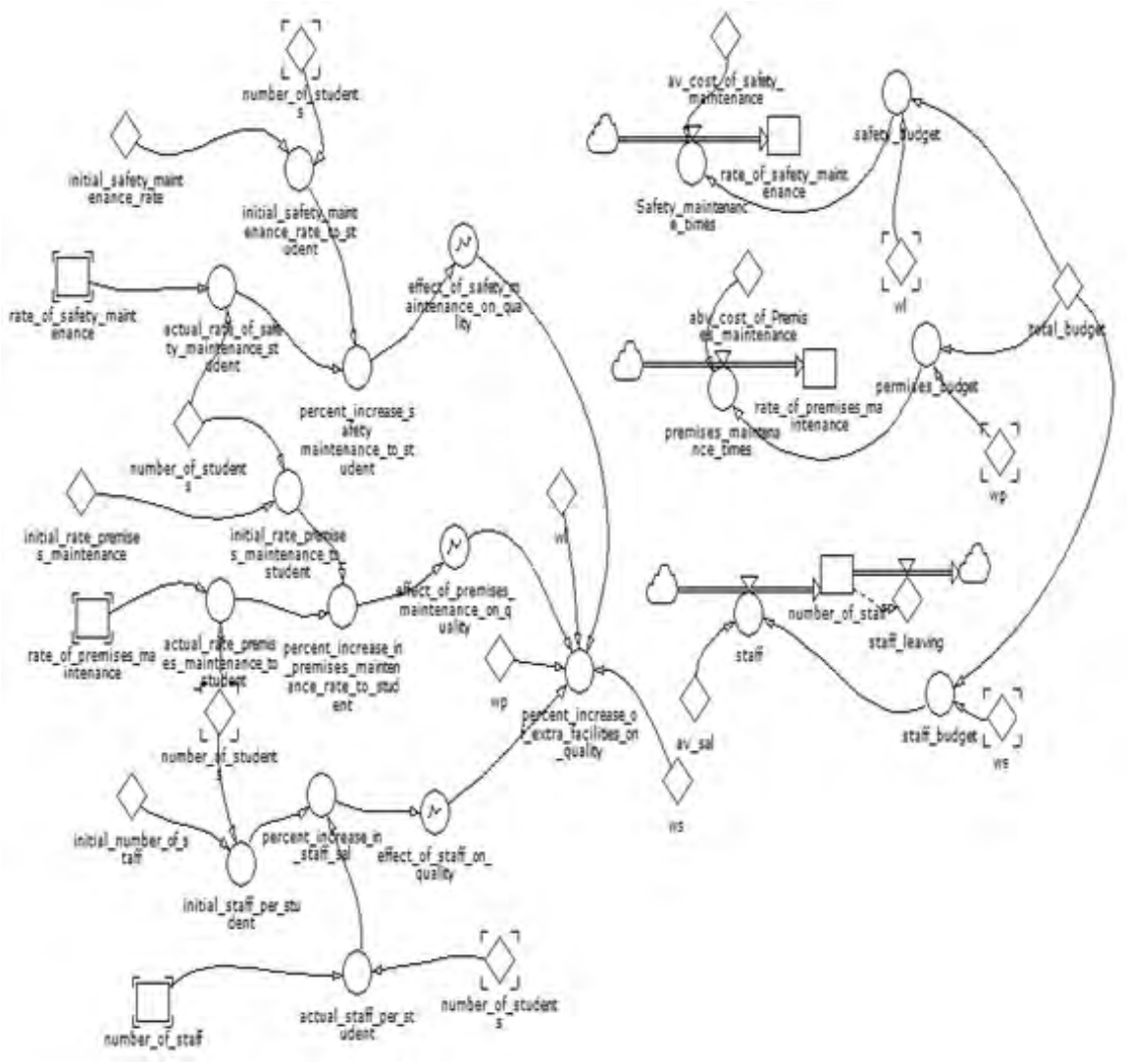


Figure (6-7-b): Extra Facilities Stock & Flow Diagram; Source: (The Researcher)

6.2.6.3 Step 3a Table Functions Used for Extra Facilities for PUBLIC University

The data acquired for these graph functions originated from the conducted facility manager interview demonstrated in the Appendix D, then the resultant mapping of each factor is represented in the screenshots displayed below.

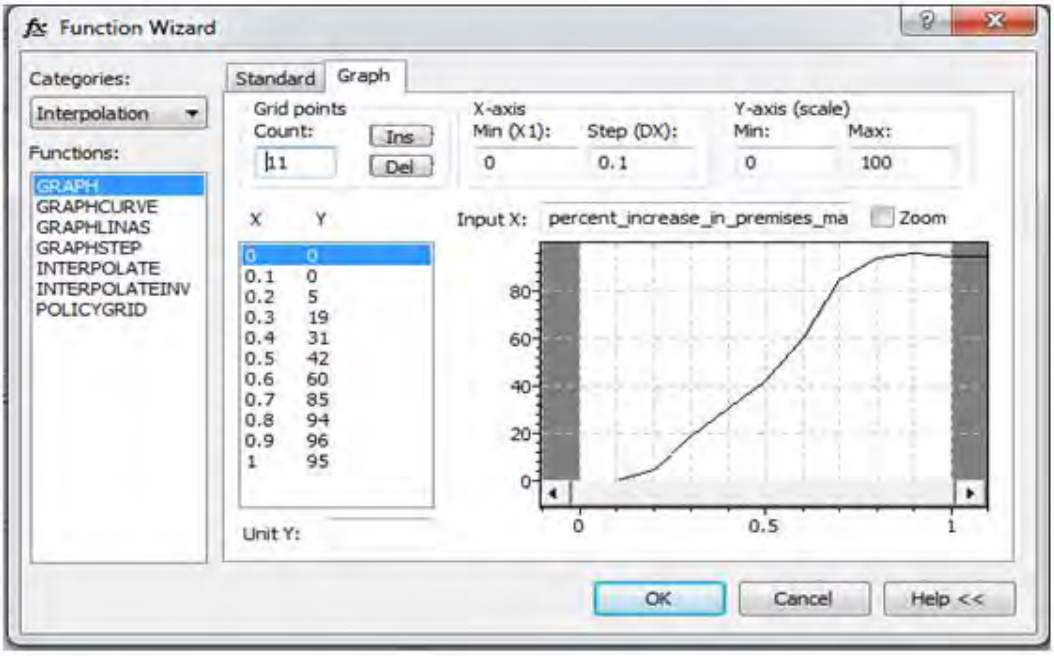


Figure (6-7-c): Premises Factor Effect on Estimated Quality; Source: (The Researcher)

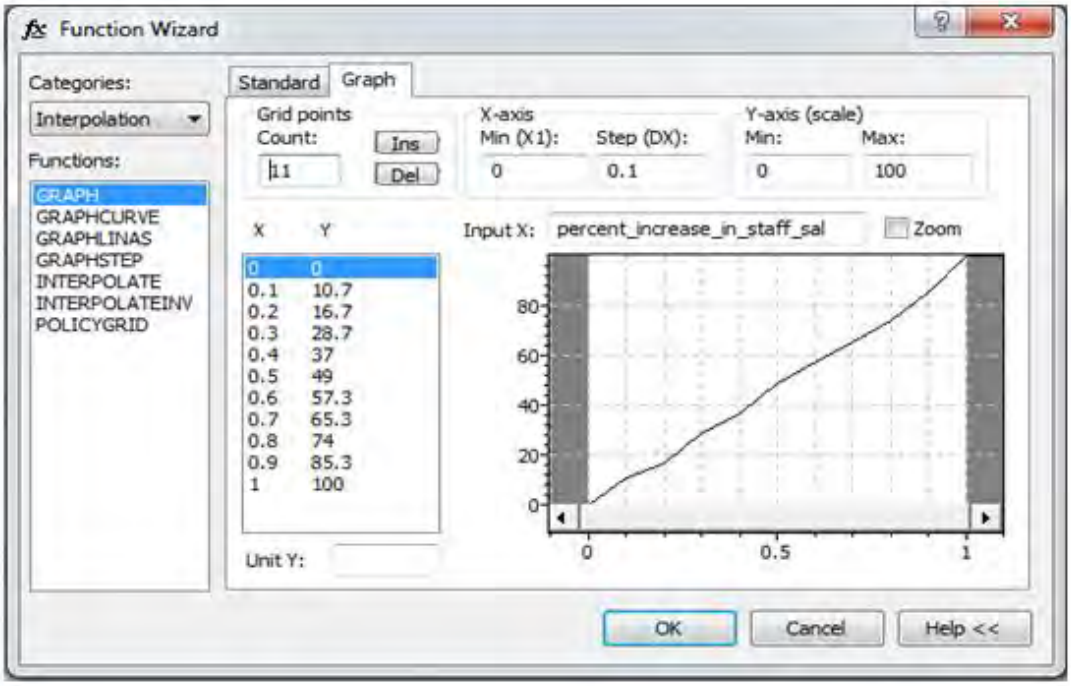


Figure (6-7-d): Staff Factor Effect on Estimated Quality; Source: (The Researcher)

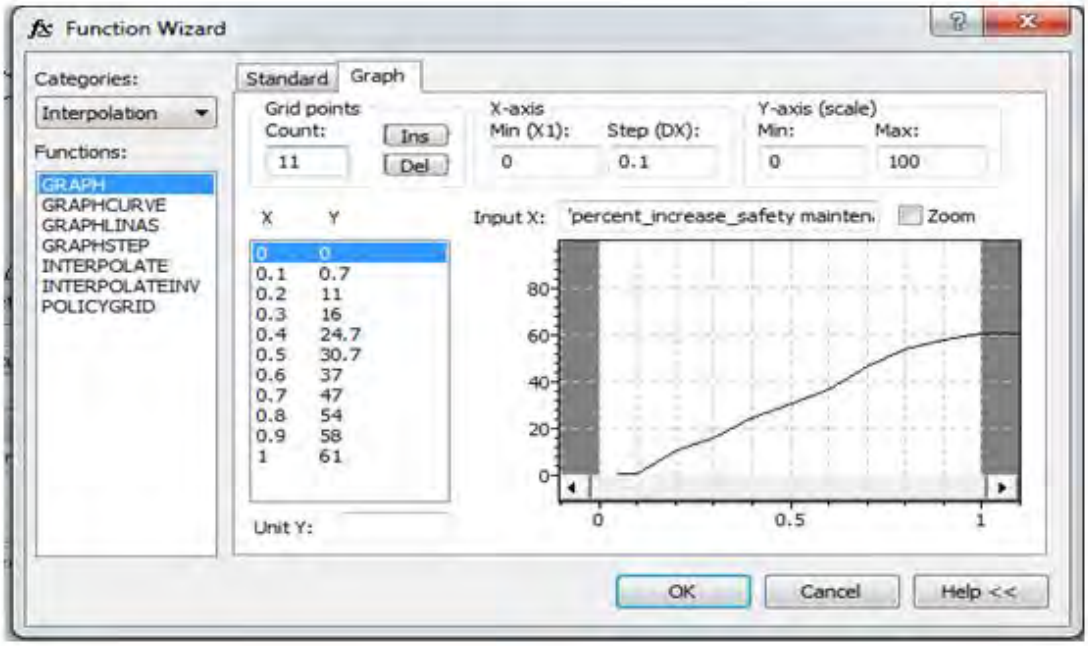


Figure (6-7-e): Safety Factor Effect on Estimated Quality; Source: (The Researcher)

6.2.6.3 Step 3b Table Functions Used for Extra Facilities for PRIVATE University

The effects on the estimated quality of the factors of these extra facilities are exposed in the following figures.

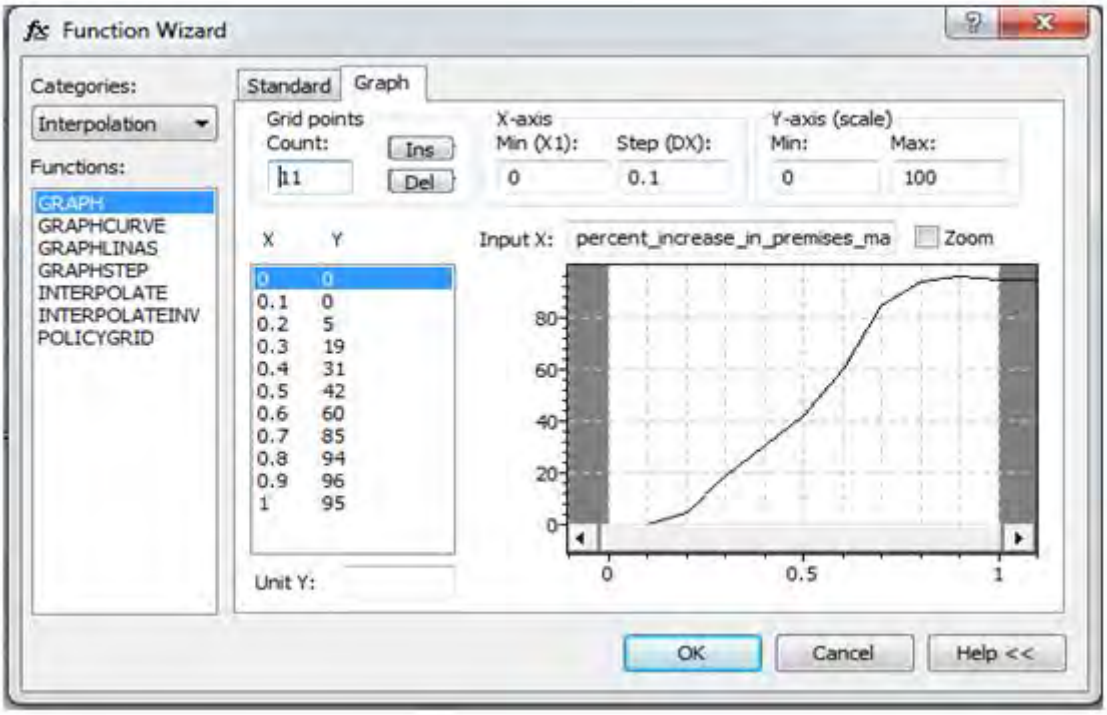


Figure (6-7-f): Premises Factor Effect on Estimated Quality for the Private University; Source: (The Researcher)

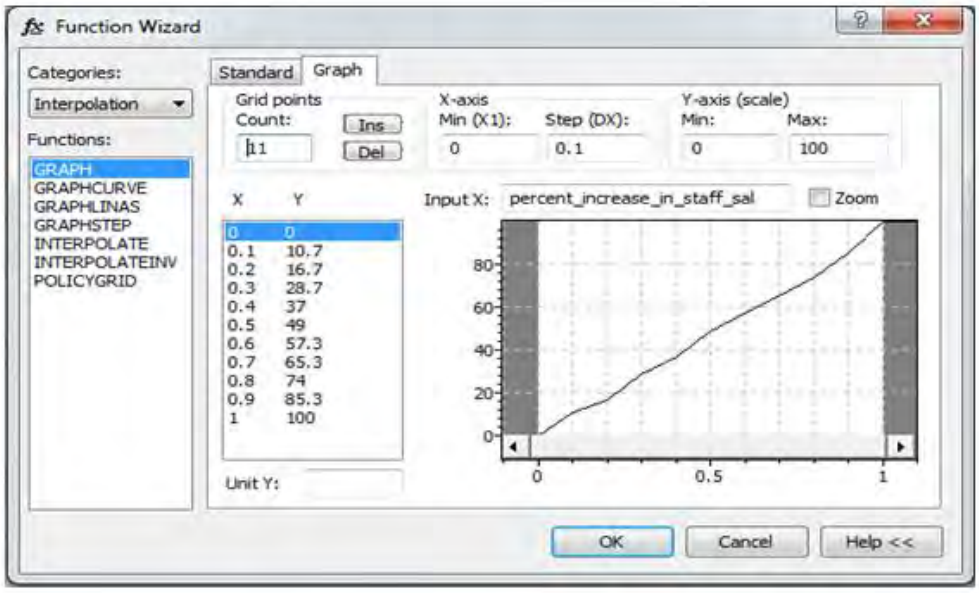


Figure (6-7-g): Staff Factor Effect on Estimated Quality for the Private University; Source: (The Researcher)

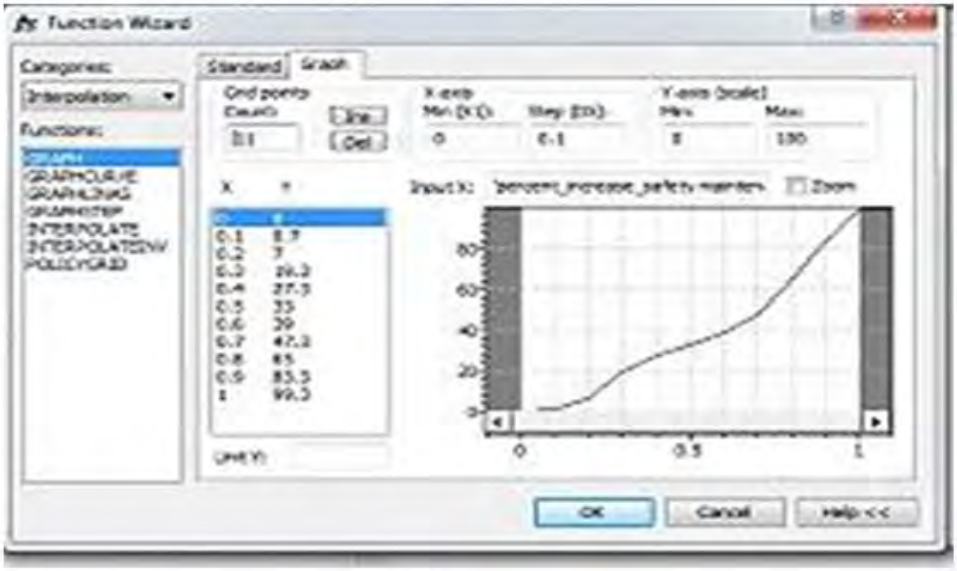
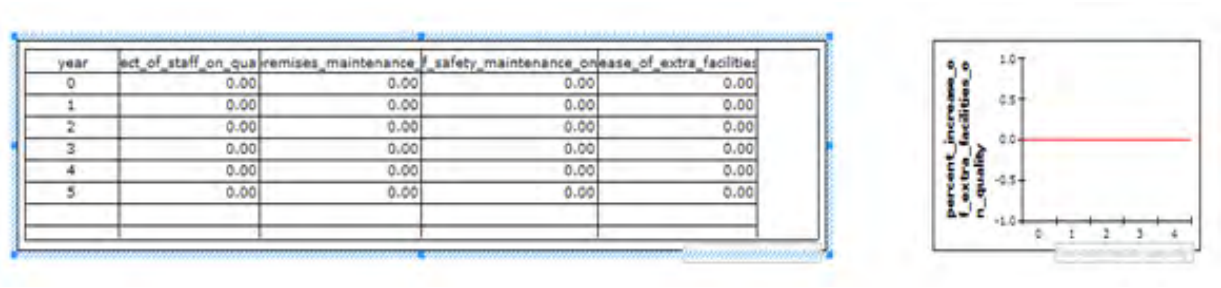


Figure (6-7-h): Safety Factor Effect on Estimated Quality for the Private University; Source: (The Researcher)

6.2.6.4 Step 4 Structural Validation of the Extra Facilities Model

6.2.6.4.1 Extreme Conditions (PUBLIC)

Figure (6-7-i) expresses that the model was run with zero budget and logical answer of zero was found. Total budget: initial value: 2000000, initial quality: 87.9, minimum value: 0, total quality: 0.



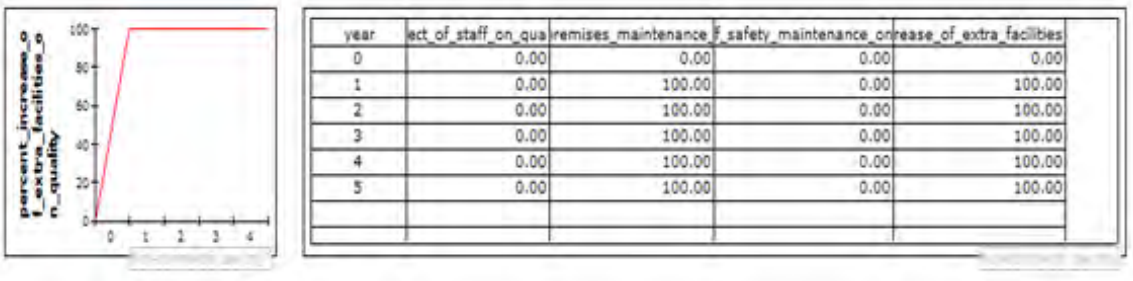
year	ect_of_staff_on_qua	remises_maintenance	f_safety_maintenance_on	ease_of_extra_facilities
0	0.00	0.00	0.00	0.00
1	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00

Figure (6-7-i): Extreme Conditions for Extra Facilities; Source: (The Researcher)

6.2.6.4.2 Parameter Sensitivity (PUBLIC)

Key parameters were chosen and their values changed slightly. Typical examples are revealed in the succeeding figures. Change percentage in maintenance was five per cent and in quality two per cent, in safety budget was ten per cent and in quality only one per cent, in number of staff was five per cent and in quality three per cent, and in staff salaries was ten per cent and in quality was four per cent.

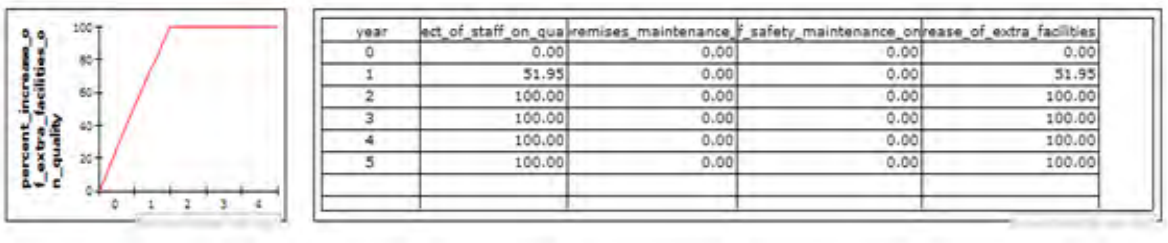
1-Premises: budget initial value: 100000, quality of factor: 100, total quality: 88.73, budget maximum value: 2000000, quality of factor 100, total quality: 100.



year	ect_of_staff_on_qua	remises_maintenance	f_safety_maintenance_on	ease_of_extra_facilities
0	0.00	0.00	0.00	0.00
1	0.00	100.00	0.00	100.00
2	0.00	100.00	0.00	100.00
3	0.00	100.00	0.00	100.00
4	0.00	100.00	0.00	100.00
5	0.00	100.00	0.00	100.00

Figure (6-7-j): Parameter Analysis for Premises Factor of Extra Facilities; Source: (The Researcher)

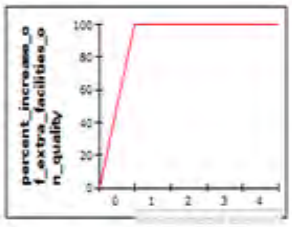
2-Staff: budget initial value: 400000, quality of factor: 43.6, total quality: 88.73, budget maximum value: 2000000, quality of factor: 100, total quality: 100.



year	ect_of_staff_on_qua	remises_maintenance	f_safety_maintenance_on	ease_of_extra_facilities
0	0.00	0.00	0.00	0.00
1	51.95	0.00	0.00	51.95
2	100.00	0.00	0.00	100.00
3	100.00	0.00	0.00	100.00
4	100.00	0.00	0.00	100.00
5	100.00	0.00	0.00	100.00

Figure (6-7-k): Parameter Analysis for Staff Factor of Extra Facilities; Source: (The Researcher)

3-Safety: budget initial value: 1500000, quality of factor: 100, total quality: 88.73, budget maximum value: 2000000, quality of factor: 100, total quality: 100.



year	ect_of_staff_on_qua	remises_maintenance	f_safety_maintenance_on	ease_of_extra_facilities
0	0.00	0.00	0.00	0.00
1	0.00	0.00	100.00	100.00
2	0.00	0.00	100.00	100.00
3	0.00	0.00	100.00	100.00
4	0.00	0.00	100.00	100.00
5	0.00	0.00	100.00	100.00

Figure (6-7-l): Parameter Analysis for Safety Factor of Extra Facilities; Source: (The Researcher)

6.2.6.4.3 Extreme Conditions (PRIVATE)

Figure (6-7-m) exhibits that the model was run with zero budgets and rational answer of zero was obtained. Total budget: initial value: 3500000, initial quality: 96.3, minimum value: 0, total quality: 0.

year	ect_of_staff_on_qua	remises_maintenance	f_safety_maintenance_on	ease_of_extra_facilities
0	0.00	0.00	0.00	0.00
1	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00

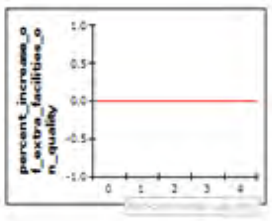


Figure (6-7-m): Extreme Conditions for Extra Facilities in the Private University; Source: (The Researcher)

6.2.6.4.4 Parameter Sensitivity (PRIVATE)

Key parameters were chosen and their values changed slightly. No substantial changes in Quality were produced which means that the parameter was not sensitive. Typical examples are revealed in the following figures.

1-Premises: budget initial value: 700000, quality of factor: 85, total quality: 96.3, budget maximum value: 3500000, quality of factor 100, total quality: 100.

year	ect_of_staff_on_qua	remises_maintenance_f	_safety_maintenance_on	ease_of_extra_facilities
0	0.00	0.00	0.00	0.00
1	0.00	85.00	0.00	85.00
2	0.00	100.00	0.00	100.00
3	0.00	100.00	0.00	100.00
4	0.00	100.00	0.00	100.00
5	0.00	100.00	0.00	100.00

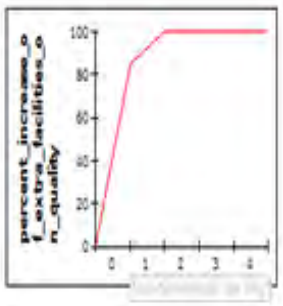


Figure (6-7-n): Parameter Analysis for Premises Factor of Extra Facilities in the Private University; Source: (The Researcher)

2-Staff: budget initial value: 1050000, quality of factor: 99, total quality: 96.3, budget maximum value: 3500000, quality of factor: 100, total quality: 100.

year	ect_of_staff_on_qua	remises_maintenance_f	_safety_maintenance_on	ease_of_extra_facilities
0	0.00	0.00	0.00	0.00
1	66.10	0.00	0.00	66.10
2	100.00	0.00	0.00	100.00
3	100.00	0.00	0.00	100.00
4	100.00	0.00	0.00	100.00
5	100.00	0.00	0.00	100.00

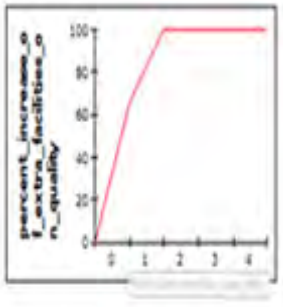


Figure (6-7-o): Parameter Analysis for Staff Factor of Extra Facilities in the Private University; Source: (The Researcher)

3-Safety: budget initial value: 1750000, quality of factor: 100, total quality: 96.3, budget maximum value: 3500000, quality of factor: 100, total quality: 100.

year	ect_of_staff_on_qua	remises_maintenance_f	_safety_maintenance_on	ease_of_extra_facilities
0	0.00	0.00	0.00	0.00
1	0.00	0.00	15.20	15.20
2	0.00	0.00	100.00	100.00
3	0.00	0.00	100.00	100.00
4	0.00	0.00	100.00	100.00
5	0.00	0.00	100.00	100.00

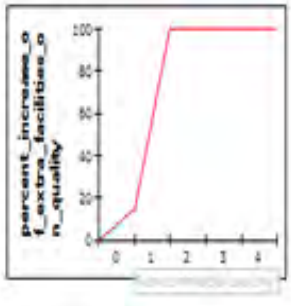


Figure (6-7-p): Parameter Analysis for Safety Factor of Extra Facilities in the Private University; Source: (The Researcher)

6.3 ASSEMBLY OF AN INTEGRATED UNIVERSITY QUALITY MODEL

For both the private and the public universities, the previous six System Dynamic models have been combined to give an overall effect of facilities on quality. The first four tests for structural consistency are still valid from the results of section 6.2. The model is assembled from the previous six models into the following final model as shown in Figure (6-8).

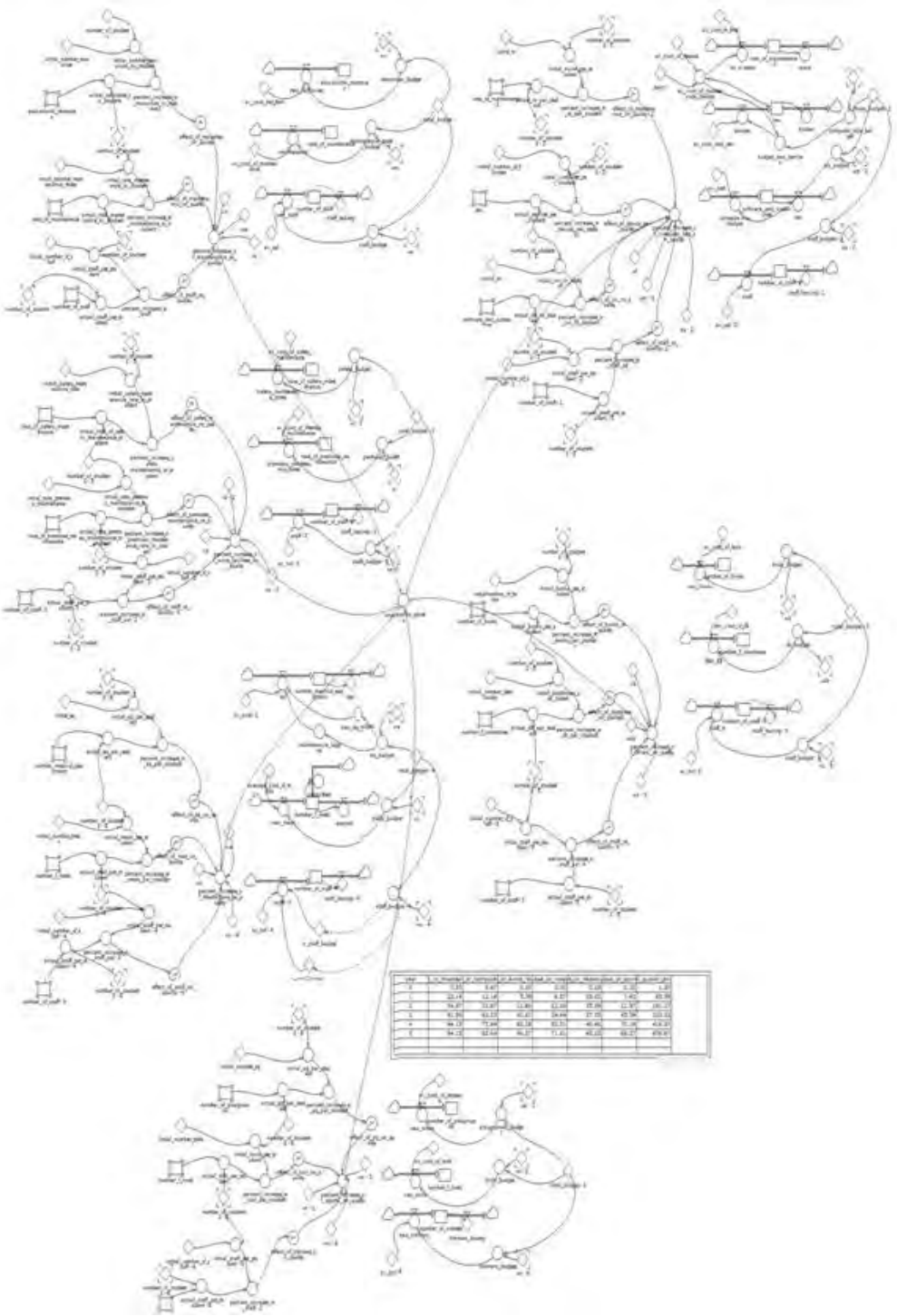


Figure (6-8): Assembled Model; Source: (The Researcher)

6.4 PUBLIC AND PRIVATE UNIVERSITIES CHOSEN

The public university chosen is **Alexandria University**, which represent a public university in Alexandria in the Arab Republic of Egypt to use in this research. It was established in 1938 as a follower of Fouad University, which was four years renamed as Cairo University, and became a separate entity in 1942. Its named was changed to Farouk University until the Egyptian Revolution in 1952 than its name changed to the University of Alexandria. The main established rector of Alexandria University was Dr. Taha Hussein. Nowadays, Alexandria University is the second biggest university in Egypt and possesses several association with different universities for on-going research.

Faculty of Science, Alexandria University was established in 1942. New departments have been founded since. It currently contains nine departments distributed among the faculty's buildings.

'Moharam Bek' building: contains the faculty's headquarter and the labs of the departments: mathematics, geology, botany, zoology and biochemistry.

'El Shatby' building: located in Aflton Street and contains the buildings established in the beginning of the sixties, it also contains the computer unit and the Electronic Microscope unit.

'Horria Road' building: contains lectures halls and the labs associated with chemistry department.

'Gomrok (Anfoshi)' building: overlooks the eastern port, next to Yacht club. It contains lectures halls and labs associated with oceanography department.

The private university chosen is the **Arab Academy for Science, Technology and Maritime Transport**, which follow the Arab League that was established in 1972. The Academy encompasses four basic colleges, which compromise many different specializations: the College of Management and Technology, the College of Engineering and Technology, the College of Maritime Transport and Technology and the School of Computing and Information Technology.

The Academy‟s learning system based on the “know-how” rather than the “know-what” in its learning system. In 1999, the AAST was certified tby ISO 9001 from the D.N.V after establishing and implementing its quality management system in its colleges. In 1992, the College of Management and Technology was founded. Its establishment came in response to the Academy‟s desire to create a source of knowledge and skills for the business sector and professionals. The College of Management and Technology graduated around 5000 students as it introduces up-to-date knowledge and practices into its curricula, and offers its programs to meet the needs of targeted market labour.

CMT is located in **Alexandria Miami Campus** (Main Headquarter). The main departments that constitute the College are: Financial Management & Accounting, Marketing & International Business, Media Management, Business Information Systems, Hotels & Tourism and the International Programs (Cardiff Metropolitan University and Coventry University). The College supports the Credit-Hour-System, which sustains flexibility in choosing the Academic or Professional Educational Program that best suits the students.

6.5 SUMMARY

Figure (5-3) in the preceding chapter represented the resultant prioritised service facilities, which were identified by the regression analysis and agreed by the experts: library services, computer labs, classrooms, health care, sport, and extra facilities such as transportation, security, safety.

This chapter first developed structurally sound System Dynamics models for these six university facilities and then combined them into an integrated model. Four steps were followed for each stage. First a causal diagram was assembled which was then developed into a System Dynamics model., The data collected was used to form the table functions for the models then structural tests were done for each.

The reason for building the model was to develop an exploratory study to provide an alternative to the current Decision Support Systems used for resource allocation by facility managers at Egyptian universities. This can take place at two levels – each of the six facilities addressed by the model and then, a higher level which looks at the integrated picture. In each case, the question to be answered is how best to allocate money from a fixed budget. “Best” is defined as “improving the quality of education”. The outputs expected from the model should provide guidance for the facility operator. At the individual level, the input to the

model is various percentages of the budget allocated to the possible spend and the outputs are an estimated value for quality improvement. Here, it is not the absolute value generated that is important but the effect that different inputs have on the quality. An overall university facility operator can perform the same tasks at an integrated level. The veracity of the results and usefulness of the model is a function of the validity of the model which is covered in section 7.1 under Abduction.

CHAPTER SEVEN

VALIDATION & IMPLEMENTATION

7.1 VALIDATION

In Chapter Six, it is shown that the model for facility management passes the structural tests stated by Sterman (2000), this means that the model runs correctly without excessive parameter sensitivity and infinities. It can therefore be assumed that the model is structurally sound. The model now needs to be "validated". The meaning of this term should be explored. When one asks "Is a model valid?", one of the answers could "is the used model reliable or credible or realistic or trustworthy, or plausible or legitimate or accurate?" All these are common understandings of the word "valid." If one looks at them as a whole, they are all implying that the user has "confidence" in the outcome. The user "trusts" the model.

One can look at this at many levels. If one takes a holistic view, then it means that the theoretical or philosophical assumptions behind the model are correct. The rules of management facility have been taken from literature and used the observation of experienced facility managers. The epistemological validity of System Dynamics is well documented and discussed in Chapter Four – Research Methods. Thus, at this level, the model can be said to be valid.

In the implementatio level, if anyone looks to the mode he will find the model uses terms that are generally understood and accepted in the field. The inputs to the model are precise and taken from published results. The outputs bear out what would be expected from these inputs i.e. the outputs are not unreasonable. As such, the model could be classified as valid.

At the very small level of the model, the model will be more applicable and practical. It has been used by practitioners and they are "confident" in its performance. This surely is a good justification of a valid model – it is accepted by its peer group.

These three levels of validity are examples of what CS Pierce called "Abduction." Most people are familiar with the terms "deduction" and "induction". The first is when a general situation is observed and from that particular patterns are inferred. This is popularised by the stories of Sherlock Holmes. From a general observation of a person"s clothes, Holmes could deduce his profession, religion, marital status and even his social habits. The second process "induction" is the reverse. Here one starts with lots of particular examples and from them

postulates a general principle or rule. It is often used in mathematics where first one proves that if some state has a particular quality, then so does the next and the next and thus for all states Abduction lies between the two. If a model is structurally sound and does not behave abnormally, then, if precise and correct inputs are fed into the model and skilled practitioners accept that the outcomes are reasonable, abduction can be used to declare that the model is valid. This is the justification for the validity of the facilities management model developed in Chapter Six.

7.2 QUALITY OF SERVICE FACILITIES IN PUBLIC & PRIVATE UNIVERSITIES

The following tables give an illustration of the outputs that can be acquired from the System Dynamics model which was illsutrated in Chapter Six for the Private Public Universities. The numerical data input is taken from published data and the weightings reflect the experience of practitioners at the Arab academy and Alexandria University. All six services are discussed in turn.

In each case, it is supposed that the practitioner has a fixed budget for that facility and the decision is to how to allocate that budget between two or three options. This is done by altering the weights. The output is the percentage increase/decrease in quality.

The following figures show some tests that have been done. These considered not exhaustive and more can be perfromed with various weightings. They are included here simply to demonstrate the power of the models.

7.2.1 Library Facilities

The data used for these runs is shown in table (7-1).

Table (7-1): Data Input for the Library Service Facility in Both Universities; (Source: The Researcher)

Item Criteria	Public University	Private University
Initial Number of Databases	50	100
Initial Number of Staff	30	15
Initial Number of Books	8400	10000
Average Cost of Book	130	130
Average Cost of Database	10000	10000
Average Salary	3200x12	4200x12
Number of Students	4200	2300
Total Budget	2066000	4460600

Several runs were made for the public university of which three are shown in table (7-2).

Table (7-2): Library Service Facility Allocations in the Public University; (Source: The Researcher)

Service Facility Factors	Books	Staff Salaries	Database	Percentage Increase/Decrease in Quality
Weight of Factor	0.3	0.4	0.3	3.2
Weight of Factor	0.5	0.2	0.3	3.0
Weight of Factor	.0.3	0.2	0.5	3.5

An optimum allocation is obtained using weights of 0.3, 0.4 and 0.3. This is what realy done in implementation in 2017 and it condidered as a benchmark. If the salary budget for administrative staff is decreased and the books and databases are increased, then there is a rise in quality. If the remaining budget is divided in favor of books instead of databases, the output is the highest increased percentage in quality. Another typically exercise was performed again for the Arab Academy, which is a private university.

Table (7-3): Library Service Facility Allocations in the Private University; (Source: The Researcher)

Service Facility Factors	Books	Staff Salaries	Database	Percentage Increase/Decrease in Quality
Weight of Factor	0.3	0.2	0.5	7.4
Weight of Factor	0.3	0.45	0.25	7
Weight of Factor	0.5	0.2	0.3	7.2

An optimum combination is obtained by using weights of 0.3, 0.45 and 0.25, which is what happened in 2017. It can be noticed that in contrast to the public university, the budget on salaries is higher which reflects the fact the staff at private universities are paid more. Despite this, if this budget is decreased the percentage increase in quality increases as in the public case. This time however, it seems that it is better to spend the money rather than books.

7.2.2 Computer Lab Facilities

The data used for these runs is shown in table (7-4) below. The computer‟s labs annual budget consists three spending categories: number of new computer equipment has yearly

added to the lab, maintenance of the current computer devices and technicians‟ salaries. It is obvious that the provision of new software version is a high contributory factor to the percentage increase in quality. The number of computer devices has the least impact perhaps as most of the students now use their personal laptops. Technicians are needed for the installation of the required software and maintenance of the devices. The service quality of the computer labs will be improved by the increase of the provision of the modern preventive maintenance. The technicians‟ wages will help in enhanceing the quality of service provided under the condition that they should be cooperative, supportive and friendly when dealing with the students.

Table (7-4): Data Input for the Computer Labs Facility in Both Universities; (Source: The Researcher)

Item Criteria	Public University	Private University
Average Cost of Devices	3000	3000
Average Staff Salary	3000*12	5000*12
Initial Number of Devices	300	250
Initial Number of Staff	100	80
Rate of Maintenance	20	18
Software and Accessories	1000	900
Total Budget	1334000	1200000

Several runs were made for the public university of which three are shown in table (7-5).

Table (7-5): Allocations for Computer Labs Service Facility in the Public University; (Source: The Researcher)

Service Facility Factors	Devices	Maintenance Rate	Staff Salaries	Software	Percentage Increase/Decrease in Quality
Weight of Factor	0.25	0.05	0.4	0.3	4.9
Weight of Factor	0.05	0.05	0. 5	0.4	5.1
Weight of Factor	0.25	0.05	0.4	0.3	5

The same exercise was repeated for the private university, the Arab Academy.

Table (7-6): Allocations for the Computer Labs Service Facility in the Private University; (Source: The Researcher)

Service Facility Factors	Devices	Maintenance Rate	Staff Salaries	Software	Percentage Increase/Decrease in Quality
Weight of Factor	0.25	0.05	0.4	0.3	8
Weight of Factor	0.05	0.05	0. 5	0.4	8.2
Weight of Factor	0.05	0.3	0.4	0.25	7.9

7.2.3 Classrooms Facilities

The data used for these runs is shown in table (7-7). All other data is given in Appendix E. The various spending options in the classrooms service facility are the provision and maintenance of the classrooms and the salaries of the teaching staff. The maintenance budget is calculated using the average cost of maintenance and the rate of maintenance, while the staff budget depends on staff total number and the average salary. After running the system for the five years, the outputs shown in the table illustrate that the maintenance effect on the classrooms quality is the most effective element, therefore the amount of budget to be assigned to maintenance should take the biggest part. The maintenance rate and its efficiency will positively affect the quality of the classrooms, the more the maintenance rate the longer the classes and the equipment will withstand.

Table (7-7): Data Input for the Classrooms Facility in Both Universities; (Source: The Researcher)

Item Criteria	Public University	Private University
Average Cost of Maintenance	100000	50000
Average Cost per Item	10000	10000
Average Salary Educational Resources	2000*12 30	2500*12 20
Maintenance Rate	5	7
Number of Staff	30	15
Number of Students	4200	2300
Total Budget	3465200	3000000

Several runs were made for a public university of which three are shown in table (7-8). It can be seen that the optimum allocation is 0.3, 0.5 and 0.2.

Table (7-8): Allocations for the Classrooms Service Facility in the Public University; (Source: The Researcher)

Service Facility Factors	Maintenance	Staff Salaries	Educational Resources	Percentage Increase/Decrease in Quality
Weight of Factor	0.2	0.5	0.3	4.9
Weight of Factor	0.3	0.5	0.2	5.1
Weight of Factor	0.1	0.4	0.5	4.8

Similar behaviour is seen as in the public case as shown in table (7-9) but the percentage increase is much bigger. The reason of that maybe due to the university attracting better staff which are paid higher salaries.

Despite the real that the budget assigned to the whole service facility is slightly less than that allocated to the same facility in public university, the estimated quality is higher because the number of classes is fewer and consequently maintenance is cheaper.

Table (7-9): Allocations for the Classrooms Service Facility in the Private University; (Source: The Researcher)

Service Facility Factors	Maintenance	Staff Salaries	Educational Resources	Percentage Increase/Decrease in Quality
Weight of Factor	0.3	0.4	0.3	8
Weight of Factor	0.3	0.5	0.2	8.4
Weight of Factor	0.2	0.4	0.4	7.9

7.2.4 Sports Services

The data used for these runs is shown in table (7-10) below. All other data is shown in Appendix H. The total budget covers the acquisition of sports instruments and the trainers‟ salaries (i.e. factors are the number of purchased tools and the number of trainers available to coach), in addition to the available space for playing courts. The tools budget relies on the average cost of tools and the number of tools, while the trainers‟ salaries depend on the average salary and the number of trainers.

Table (7-10): Data Input for the Sports Facility in Both Universities; (Source: The Researcher)

Item Criteria	yt i sle inb c i lbuP	yi b rucinb c i lbuP
Average Cost of Tools	5000	7000
Average Salary	2000*12	4000*12
Number of Tools	50	250
Number of Playgrounds	7	10
Number of Students	4200	2300
Number of Trainers	15	15
Total Budget	140000	630000

Several runs were made for a public university of which three are shown in table (7-11).

Table (7-11): Allocations for the Sports Service Facility in the Public University; (Source: The Researcher)

Service Facility Factors	Tools	Trainers	Playgrounds	Percentage Increase/Decrease in Quality
Weight of Factor	0.3	0.4	0.3	6.4
Weight of Factor	3.3	3.1	3.5	6.6
Weight of Factor	3.1	3.4	3.4	6.3

The private university (the Arab Academy) had a budget of 140000 Egyptian pounds to spend on Sports Services. All other data is shown in Appendix F. The budget allocated to that service facility is relatively high than that in case of public university. It is reasonable as sports facility is conserved an important service in reference to the students who can afford the payable fees of private universities. Several runs were made for a private university of which three are shown in table (7-12).

Table (7-12): Allocations for the Sports Service Facility in the Private University; (Source: The Researcher)

Service Facility Factors	Tools	Trainers	Playgrounds	Percentage Increase/Decrease in Quality
Weight of Factor	0.3	0.4	0.3	8
Weight of Factor	3.5	3.1	3.3	8.8
Weight of Factor	3.1	3.4	3.4	8.6

Here the case is different. The budget allocated to that service facility is relatively high than that in case of public university. It is reasonable as sports facility is conserved an important service in reference to the students who can afford the payable fees of private universities.

7.2.5 Health Care Services

The data used for these runs is shown in table (7-13). All other data is detailed in Appendix G. The budget for Alexandria University was 464000 Egyptian pounds. It can be seen that the optimum allocation is 0.2, 0.4 and 0.4.

Table (7-13): Data Input for the Health Care Facility in Both Universities; (Source: The Researcher)

Item Criteria	yt i sh e inb c i lbuP	yi b rucinb c i lbuP
Average Salary	3000*12	4000*12
Average Cost of Medications	300	300
Number of Medication	500	400
Number of Medical Equipment	1000	700
Number of Staff	100	50
Number of Students	4200	2300
Total Budget	464000	500000

The little allocated budget for this service facility is related to the centralization of surgeries and specialized treatment in hospitals for the academic staff as well as the students. The university campus provides only the emergency treatment and any further required treatment should be taken outside the campus through the transfer of the patient to external clinics or governmental hospitals. Several runs were made for a public university of which three are shown in table (7-14).

Table (7-14): Allocations for the Health Care Service Facility in the Public University; (Source: The Researcher)

Service Facility Factors	Equipment	Staff Salaries	Medications	Percentage Increase/Decrease in Quality
Weight of Factor	0.3	0.4	0.3	1.5
Weight of Factor	3.1	3.4	3.4	1.6
Weight of Factor	3.1	3.4	3.4	1.4

The private university (the Arab Academy) had a budget of 3000000 Egyptian pounds to spend on health care facilities. All other data is shown in Appendix G. Here the case is different. The budget allocated to that service facility is relatively high than that in case of public university. It is reasonable as sports facility is conserved an important service in reference to the students who can afford the payable fees of private universities. Better quality with bigger allocated budget is acquired due to the availability of more equipment and

medications as well as the lower number of doctors and nursing staff. Several runs were made for a private university of which three are shown in table (7-15).

Table (7-15): Allocations for the Health Care Service Facility in the Private University; (Source: The Researcher)

Service Facility Factors	Equipment	Staff Salaries	Medications	Percentage Increase/Decrease in Quality
Weight of Factor	0.3	0.4	0.3	4.1
Weight of Factor	3.1	3.4	3.4	4.3
Weight of Factor	3.1	3.4	3.4	4.3

7.2.6 Extra Facilities Services

The data used for these runs is shown in table (7-16) below. All other data is detailed in Appendix H. The budget for Alexandria University was 2000000 Egyptian pounds. Safety needs, premises, parking, and special needs accesses are the most common factors in extra facilities. The maintenance of these factors has the utmost substantial impact on the quality of extra facilities. Besides, also the staffs responsible for these facilities are considered as important factor in increasing the estimated quality. The premises (greeneries, courts, cafeterias, and so on) positively affect the quality as well. The safety maintenance (fire fighting, escaping precautions and so on) is highly appreciated. The salaries paid for the staff that is in charge of maintenance, formulate a major factor for better performance and consequently achieving higher quality. It can be seen that the optimum allocation is 0.05, 0.2 and 0.75.

Table (7-16): Data Input for the Extra Facilities in Both Universities; (Source: The Researcher)

Item Criteria	**yt i sh e inb c i lbuP**	**yi b rucinb c i lbuP**
Average Cost of Premises Maintenance	500	50000
Average Cost of Safety Maintenance	60	10000
Average Salary	3000*12	4000*12
Rate of Premises Maintenance	5	100
Rate of Safety Maintenance	200	200
Number of Staff	100	100
Number of Students	4200	2300
Total Budget	2000000	3500000

Many runs are done for the public university of which three are shown in table (7-1 7).

Table (7-17): Allocations for the Extra Facilities Service in the Public University; (Source: The Researcher)

Service Facility Factors	Premises	Staff Salaries	Safety	Percentage Increase/Decrease in Quality
Weight of Factor	0.3	0.4	0.3	8.5
Weight of Factor	3.35	3.1	3.75	8.7
Weight of Factor	3.1	3.4	3.4	8.3

The private university (the Arab Academy) had a budget of 3500000 Egyptian pounds to spend on extra facilities. All other data is shown in Appendix H. The percentage of the high quality attained is due to the importance of these facilities and the compulsion of its existence speciacally in private sector. Many runs are done for the private university of which three are shown in table (7-18).

Table (7-18): Allocations for the Extra Facilities Service in the Private University; (Source: The Researcher)

Service Facility Factors	Premises	Staff Salaries	Safety	Percentage Increase/Decrease in Quality
Weight of Factor	0.3	0.4	0.3	9.5
Weight of Factor	3.1	3.3	3.5	.9.8
Weight of Factor	3.1	3.4	3.4	9.1

7.3 INTEGRATED MODEL

Table (7-19) and figure (7-1) below shows that there an increase in the quality in the public university (Alexandria University) and subsequently table (7-20) and figure (7-2) exhibit the increase in the private university (Arab Academy) overall quality in the Egyptian context.

Table (7-19): Increase in Quality of the Six Service Facilities in the Public University; (Source: The Researcher)

Six Service facilities in the Public University						
Service Facility	Library	Sports	Health Care	Classrooms	Extra Facilities	Computer Labs
Derived Weight of Factor	0.218	0. 014	0.049	0.36	0.21	0.14
% Increase in Quality	5.56%					

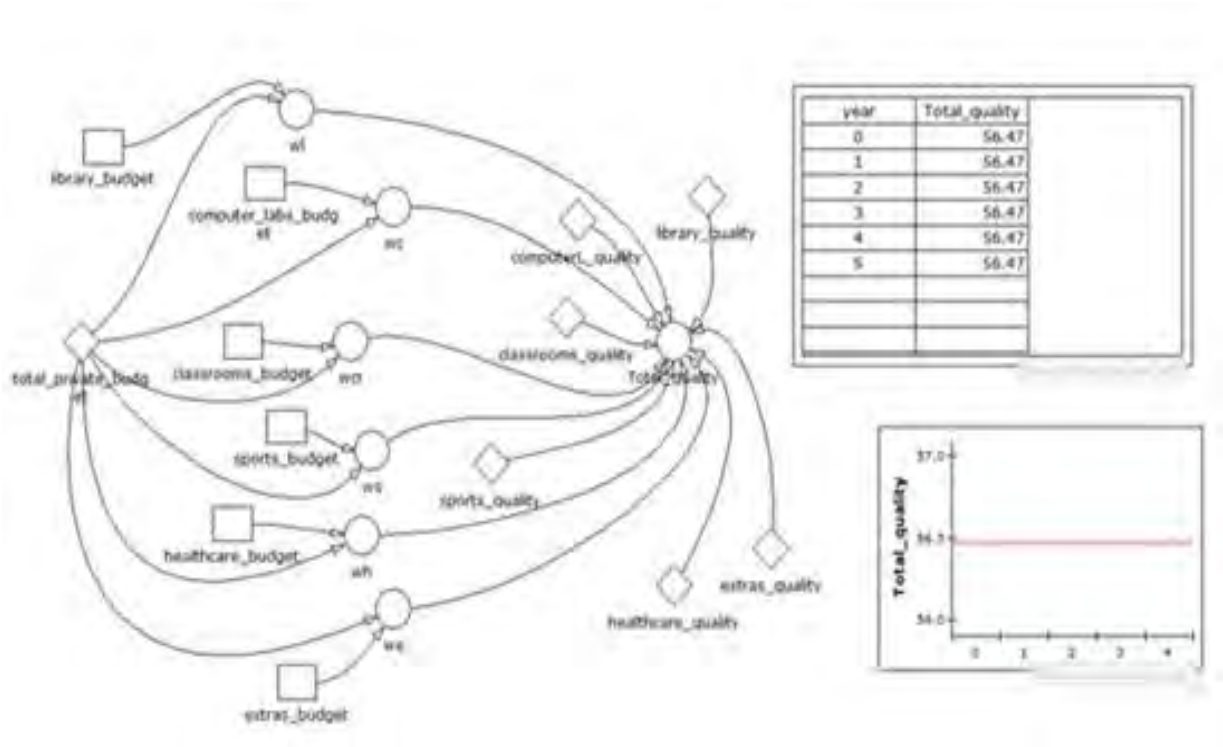


Figure (7-1): Quality for the Public University; Source: (The Researcher)

Table (7-20): Increase in Quality of the Six Service Facilities in the Private University; (Source: The Researcher)

Six Service facilities in the Private University						
Service Facility	Library	Sports	Health Care	Classrooms	Extra Facilities	Computer Labs
Derived Weight of Factor	0.28	0. 039	0.189	0.18	0.22	0.07
% Increase in Quality	7.42%					

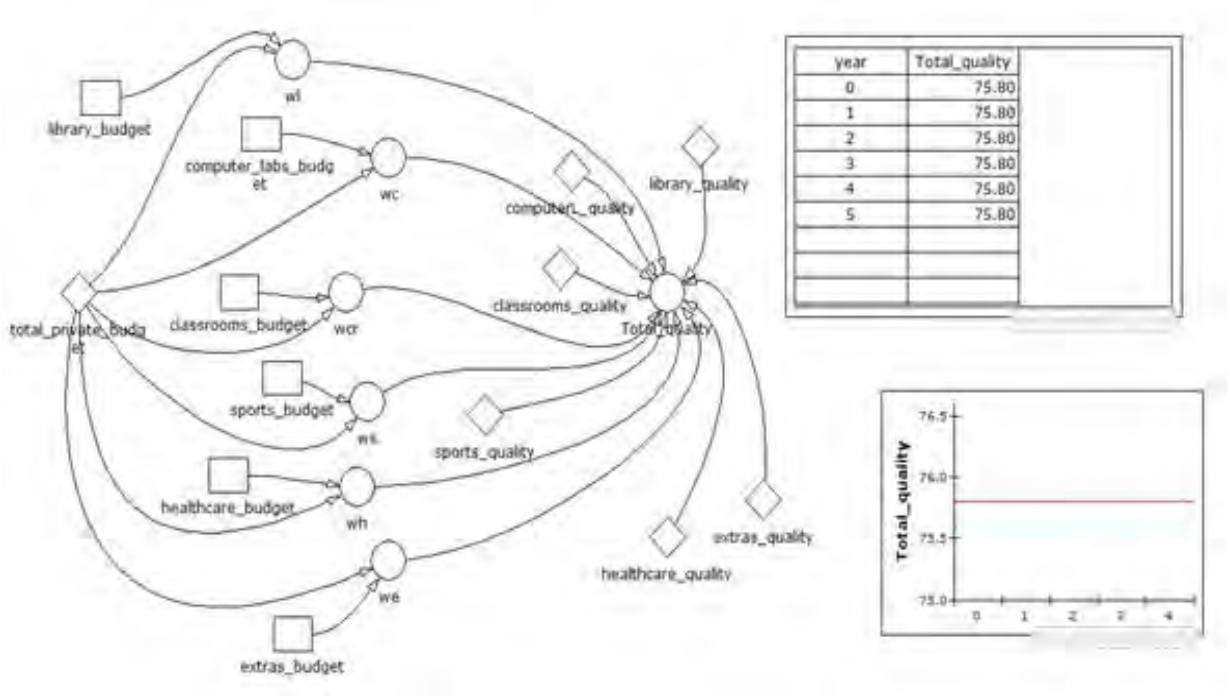


Figure (7-2): Quality for the Private University; Source: (The Researcher)

As can be seen that the service facility that was assigned the biggest amount of the total budget in the private university is the Library Services facility whereas in case of the public university the service facility that was given the prevalent portion of the overall allocated budget is the Classrooms facility.

7.4 IMPLEMENTING THE MODEL

The main reason for this study is to examin the combination of weights and correspondingly the allocated budgets to improve quality.

The proposed integrated model consists of two levels – it has six service functions which themselves have various budget allocation options. These are analysed and suggested optimum allocations are discussed in section 7.3. Using these individual budget allocations, an analysis of various allocations between the different service facilities can then be perfromed. The procedure followed in this section is as follows. First, each service function was given a weight of 50% and the others ten per cent. This was to find the most significant contributor (all other things being equal). The second stage was then to fix this service budget and to try and find the second most significant contributor. The process can then b be repeated to finally produce a priority list. This process is done for Alexandria University (the

public example) and for the Arab Academy (the private one).To recap for all runs the service facilities under investigation are:

Library Facilities

This funds books, databases and library staff. An optimum shared allocation for this was found to be a division of 30%, 30% and 40%, which is fixed for the subsequent runs described below.

Computer Labs

This has to fund devices, their maintenance, staff salaries (technical) and software. An optimum shared allocation for this was found to be a division of 55%, 50% and 40%, which is fixed for the subsequent runs described below.

Classrooms

This has to fund the education resources (including physical classrooms), their maintenance and the salaries of the academic staff. An optimum shared allocation for this was found to be a division of 20%, 30% and 50%, which is fixed for the subsequent runs described below.

Sports Services

This has to fund equipment (tools), trainers and the sports fields. An optimum shared allocation for this was found to be a division of 30%, 20% and 50%, which is fixed for the subsequent runs described below.

Health Services

This has to cover equipment, medical staff salaries, and medications. An optimum shared allocation for this was found to be a division of 20%, 30% and 40%, which is fixed for the subsequent runs described below.

Extra Facilities

This is a catch all for what is left which includes premises, salaries and safety. An optimum shared allocation for this was found to be a division of 20%, 30% and 50%, which is fixed for the subsequent runs described below. The procedure is covered under six scenarios – three for the public and three for the private university.

7.4.1 First Scenario for Integrated Model (Public)

In table (7-21), the idea was to see which service is most significant. Accordingly, each service facility was given a weight of 50% and the other ten per cent. The data used in the model is that was used in section 7.2, which covered the individual facilities.

Table (7-21): First Scenario for Integrated Model (Public); Source: (The Researcher)

Total Budget 9,469,200 Egyptian pounds						
Six Service Facilities	**Weight Derived**	**Weight Derived**	**Weight Derived**	**Weight Derived**	**Weight Derived**	**Weight Derived**
Library Services	3.5	3.1	3.1	3.1	3.1	3.1
Computer Labs	3.1	3.5	3.1	3.1	3.1	3.1
Classrooms	3.1	3.1	3.5	3.1	3.1	3.1
Sports	3.1	3.1	3.1	3.5	3.1	3.1
Health Care	3.1	3.1	3.1	3.1	3.5	3.1
Extra Facilities	3.1	3.1	3.1	3.1	3.1	3.5
% Increase in Quality	6.1	6.3	6.7	5.5	4.9	5.3

The six runs show that for Alexandria University, the more significant service is Classrooms.

7.4.2 Second Scenario for Integrated Model (Public)

The classroom facility was then set at 40% and the other five facilities were varied to find the second most significant one. These five runs are shown below in table (7-22).

Table (7-23): Second Scenario for Integrated Model (Public); Source: (The Researcher)

Total Budget 9,469,200 Egyptian pounds					
Six Service Facilities	**Weight Derived**	**Weight Derived**	**Weight Derived**	**Weight Derived**	**Weight Derived**
Library Services	3.35	3.4	3.35	3.35	3.35
Computer Labs	3.4	3.35	3.35	3.35	3.35
Classrooms	3.4	3.4	3.4	3.4	3.4
Sports	3.35	3.35	3.4	3.35	3.35
Health Care	3.35	3.35	3.35	3.4	3.35
Extra Facilities	3.35	3.35	3.35	3.35	3.4
% Increase in Quality	6.5	6.3	5.5	3.3	4.1

It appears that the second most significant factor is the computer provision.

7.4.3 Third Scenario for Integrated Model (Public)

Classrooms and Computer labs were now fixed and four runs were done to find the third most significant which are shown in table (7-23).

Table (7-23): Third Scenario for Integrated Model (Public); Source: (The Researcher)

Total Budget 9,469,200 Egyptian pounds				
Six Service Facilities	**Weight Derived**	**Weight Derived**	**Weight Derived**	**Weight Derived**
Library Services	3.15	3.35	3.35	3.35
Computer Labs	3.3	3.3	3.3	3.3
Classrooms	3.3	3.3	3.3	3.3
Sports	3.35	3.15	3.35	3.35
Health Care	3.35	3.35	3.15	3.35
Extra Facilities	3.35	3.35	3.35	3.15
% increase in Quality	6.5	6.3	5.5	3.3

It seems that this is Library services. This process was repeated, to find the fourth, fifth and consequently the sixth considered the most significant factor. The model suggested that the services should have budgets prioritized in the following order: Classrooms, Computer labs, Library services, Sports facilities, extra facilities and Health services. This is an example of how to use the model as a tool for Decision Support for financial administrators at a university.

7.4.4 Fourth Scenario for Integrated Model (Private)

The next three tables show similar analysis for the Arab Academy, which is an example of a private university. In 2017, their budget was considerably higher than Alexandria University at 15790600 Egyptian pounds. All precise data for 2017 is shown in the appendix. The same six services are examined but the optimum allocations within each individual service are different as shown in suggested in section 7.3 are different. The library is divided in the ratio 35, 25%, 45%; computer labs in the ratio 55%, 50% and 40%; the classrooms are 30%, 50% and 20%; the Sports facilities 30%. 20% and 50%, Health 20%, 40% and 50% and the Extra Facilities 20%, 30% and 50%. Table (7-24) shows the first stage of the process i.e. to identify the most significant contribution.

Table (7-24): Fourth Scenario for Integrated Model (Private); Source: (The Researcher)

Total Budget 15,790,000 Egyptian pounds						
Six Service Facilities	**Weight Derived**	**Weight Derived**	**Weight Derived**	**Weight Derived**	**Weight Derived**	**Weight Derived**
Library Services	3.5	3.1	3.1	3.1	3.1	3.1
Computer Labs	3.1	3.5	3.1	3.1	3.1	3.1
Classrooms	3.1	3.1	3.5	3.1	3.1	3.1
Sports	3.1	3.1	3.1	3.5	3.1	3.1
Health Care	3.1	3.1	3.1	3.1	3.5	3.1
Extra Facilities	3.1	3.1	3.1	3.1	3.1	3.5
% Increase in Quality	6.1	6.8	6.3	5.5	4.9	5.3

In this scenario we can conclude that the computer labs were deemed most significant.

7.4.5 Fifth Scenario for Integrated Model (Private)

Table (7-25) shows the results of five runs to find the second biggest contributor.

Table (7-25): Fifth Scenario for Integrated Model (Private); Source: (The Researcher)

Total Budget 15,790,000 Egyptian pounds					
Six Service Facilities	**Weight Derived**	**Weight Derived**	**Weight Derived**	**Weight Derived**	**Weight Derived**
Library Services	3.35	3.4	3.35	3.35	3.35
Computer Labs	3.4	3.35	3.35	3.35	3.35
Classrooms	3.4	3.4	3.4	3.4	3.4
Sports	3.35	3.35	3.4	3.35	3.35
Health Care	3.35	3.35	3.35	3.4	3.35
Extra Facilities	3.35	3.35	3.35	3.35	3.4
% Increase in Quality	6.5	5.5	6.3	3.3	4.1

The results show that the second is the most significant factor is the sports facility.

7.4.6 Sixth Scenario for Integrated Model (Private)

The sixth scenario is shown in four runs to discover the third most significant factor. Table (7-26) shows the results of the sixth scenario.

Table (7-26): Sixth Scenario for Integrated Model (Private); Source: (The Researcher)

Total Budget 15,790,000 Egyptian pounds				
Six Service Facilities	**Weight Derived**	**Weight Derived**	**Weight Derived**	**Weight Derived**
Library Services	3.15	3.35	3.35	3.35
Computer Labs	3.3	3.3	3.3	3.3
Classrooms	3.3	3.3	3.3	3.3
Sports	3.35	3.15	3.35	3.35
Health Care	3.35	3.35	3.15	3.35
Extra Facilities	3.35	3.35	3.35	3.15
% Increase in Quality	6.5	6.3	5.5	3.3

It can be seen that extra facilities (which encompass safety is the third factor. After completing the process, the priority list for the Arab academy (as an example of a private university is as follows: computer provision, sports, safety, classrooms, library provision and health services.

7.5 COMMENTS

The process followed in the scenarios is not the only possible one. It is included to demonstrate how the models can be used to aid decision-making. Possible criticisms are:

a) Since there is a high degree of interdependency between the variables, the process will not necessarily be accurate.
   This is indeed true, but the researcher would argue that it will give a good indication of the priorities. Many more runs could be done to check the accuracy of the prediction. One obstacle is that there could be a minimum budget needed for a facility. This could be due to maintenance i.e. maintaining the provision that is already in place. This can easily be handled by a more thoughtful allocation of the weights.
b) Every university is different. It depends on its immediate (local) competition, its location and its reputation.

This is obviously true but can be accommodated in the models by accurate data and judicious weightings.

The comparison between the private and public universities is interesting. The priorities are summarised in table (7-27).

Table (7-27): Priorities Concluded for Both Public & Private Universities; Source: (The Researcher)

ysc srn vi br in b ci lbuP	yi ri ye rv cr P
s moCCasaC	Computer
Computer	Sports
yrasosL	Extra Facilities
s taspC	s moCCasaC
ht omHpCare	Library
Extra Facilities	ht omHpCare

The changing priority of classrooms could reflect the fact that this is a problem (due to lack of funding) with the public university whereas the private one has adequate classrooms and budgets are needed only for maintenance. As the private one has a better infrastructure, then this may explain the prominence of the sport facilities.

These are just speculations that arise out of the modelling and the researcher is not giving definitive pronouncements. It is mentioned here as it shows the debate that can be generated by using this model as a tool. This is one of the advantages of such research as it allows

flexibility in decision-making and enables budget allocations to be investigated without having to actually spend the money.

7.6 SUMMARY

Even though the percentage of spending of higher education public in the total education budget considered high, but public expenditures on education is relatively low, and expenditures per student at the higher education level are relatively small. The results shows that the public institutes and universities are having a problem of of low resources regarding to teaching members, infrastructure, lab‟s equipment, and learning materials. It is very obvious that the mixing between the rapidly increasing in colleges enrolment and low resources lead to more deterioration of most of public higher education institutions service quality.

This chapter deals with the validation of the System Dynamic models. It then shows how the models can be used as decision support systems to decide on budget allocations. It is found that there are some counter-intuitive differences between the private and the public universities in Egypt.

CHAPTER EIGHT

CONCLUSION & RECOMMENDATIONS

8.1 ACHIEVED RESEARCH OBJECTIVES

Research objectives‟ clarify the conceptual framework that guides the research writing process to enable the reader to place this particular research problem under study in the context of knowledge, and then help in addressing the anticipated implications of the results on the development of scientific knowledge. This was indicated in chapter one. The following will outline how the research objectives were achieved throughout the study duration.

A comprehensive literature review has been performed in chapter two and three to outline the major existing higher education quality management models and the decision support systems, specificially those performed in academic management planning field, for the justification of the System Dynamics approach selection, which is aimed at the effective management of the service facilities in universities. The research has conducted an exploratory study of a Decision Support System for facilities Management in Egyptian Public and Private Universities.

Then the portrayal of the research methodology is clearly explained in chapters four and five to end up with the most influential six facilities that should be given the priority in budget distribution when a resource allocator is assigning the appropriate fund in apportioning the overall financial plan. These six facilities; being library services, computer laboratories, classrooms, health care, sports, and other premises, came from the analysis of the questionnaire survey produced of the conducted interviews with the facilities‟ managers in the Egyptian universities encompassing twenty public universities and twenty three private university.

After that, the building of the System Dynamics model takes place in chapter six with the detailed demonstrations of the items that shpae the causal loops and the structural validation tests that were followed on through the verification of the domain experts‟ evaluation of the model. Chapter seven show the implementation of the proposed model at the Arab Academy for Science & Technology as a case study to definitive adoption of the modelling tool that can be generalised for the educational sector to assist in attaining better perceived quality in universities. Several scenarios for resource allocators are elaborated to estimate the perceived

quality in higher education in Egyptian Universities that could be adjusted for best distribution of the budget in correspondence to policy makers.

Finally comes chapter eight to assess the achievement of the research aim and the appropriateness of research question through the provision of a set of recommendations for resource allocators to follow of how best to use the limited funding available in Egyptian Universities. Then the suggestions for future research are listed.

8.2 CONTRIBUTION TO KNOWLEDGE

The main contribution to knowledge is represented in the developed model that acts as a modelling tool to better assign the obtainable budget to the most influential facilities that would improve the quality of education in universities and accordingly achieve efficient allocation of resources and proficient decision-making for facilities management. Additionally, the deduced facilities, which influence and add value to the perceived quality to students in higher education, were derived from the conducted interviews with service facilities‟ managers in both public and private universities and the proceeding piloted survey. In addition, the quantification of the attained total quality in the educational sector into measurable percentage signifies a contribution.

Management and decision-making processes come within a composite system that includes a number of separate stakeholders, accompanied with differential resource flows and attitude that is exemplified through several feedback loops. Consequently, the adoption of the broad approach of systems thinking and the utilisation of the System Dynamics method offer a good framework in evaluation of different performance indicators and improvements opportunities. In general, system thinking enables a clear representation of process, structure and method in which effects can be derived from causes and the dynamics of the proposed decision-making could be appropriately explained in regards to the overall institutional situation. In addition, successively any refined alteration could occur to obtain the desired outcome that best suits the institutional context. Furthermore, System Dynamics handles Soft Variables which are interdependent which is important in the context of this research.

It is extremely questionable that higher education in Egypt can attain its large-scale enrolment expansion and quality improvement goals regaring to the traditional type of funding higher education institutions primarily with limited budgetary resources. In the private universities, the decision makers need to impelent a sustainable funding strategy that

would rationally support its objectives and long-term reshape. The suggested model would provide guidance about the desirable level of funding, possible avenues for resource diversification, and more efficient budget distribution among institutions and students.

8.3 GENERAL COMMENTS

New insights on quality manifestations and its implementation particularly in educational sector are needed. Education does not have finished physical products like industry but has outputs - graduating students, and research. It deals with human improvement, which demands high commitment and an inspired work environment. Educational quality can be regarded value added to the education process, fitness of educational outcome to market requirements, conformance of output to planned goals, and fulfilling customer‟s expectation of education. It is always dependent on the presence of high-level assurance of customer satisfaction at market costs within markets condition. Thus, perceived quality directs to a potential future and its enhancement is a never-ending process.

The research of Harris and Baggett in 1992 categorised quality management into three basic rules. The first concentrates defines service quality improvement by means of the training given to the employees to enhance their capabilities. The second focuses on the enrichment of the employees‟ contribution to the education process and the third principle is related to accredited standards in the contracted service.

Rodrigues and Leekha (2012) focus on the ABET criteria which can be used as quality measures. Their research considers factors such as the availability of facilities, curriculum, faculty contribution, and the learning and teaching process. They suggest that the availability of facilities affects the increase of quality in the educational system, and thus management should invest in various factors within the system. In Mikulskiene and Mazrimiene (2013) study of the quality of doctoral educational system, a self-regulating system dependent on state-determined variables was observed. Oyo et al. (2008) employ another model for reviewing the related variables in the Ugandan educational system to improve the higher education quality.

Simulation allows these various scenarios to be studied and subsequently possible quality improvements‟ policies emerge. University spending needs to keep its facilities, such as library services, at a minimum level.

Several studies target the management of higher education systems using the system dynamics methodology. The fundamental influencing factor is the budget. There is no generic funding system for universities which makes it difficult to determine the precise relationship between the funding and the allocation of resources. This research has demonstrated that the composite non-linearity of higher education funding and the perceived quality in universities can be appropriately addressed using the System Dynamics methodology which can offer current and future analysis with rational estimated quantitative measures, by using a coherent interpretation of causal relationships between variables

Frances et al. (1994) examine its effect on American higher education at the University of Houston. Dahlan and Yahaya (2010) use a system dynamics model for the management process of university capacities. They concentrate on balancing available capacities in the system involving the facilities and the lectures and the total number of enrolled students. Numerous policy factors like the allocations of facilities, financial aid, and the acceptance policies were encompassed in their research. Strauss and Borenstein (2014) developed a system dynamics model as a learning tool for decision-makers to investigate the influence of different factors on the increase rate of higher education enrolment in Brazil. The variables combined in the model consist of demand, supply, goals, regulation, and the balance between private and public sections. They compared their results for model validation with real data. Barlas and Diker (2000) offer another simulated model for strategy selection in academic systems to provide a solution for the dilemma of the educational quality, faculty-to-student ratio, and research productivity. Skribans et al. (2013) construct a model to study the growth of the third generation universities with innovation and research centres to draw attention to the significance of the development capability and innovative technologies management. Barnabe (2004) examines the reform of higher education system through capturing the influence of long-term management policies on teaching and research performance.

Overall, the funding in the developing countries rests on the planning activity and budget allocation. The distribution of the budget is normally based on the previous years‟ allocation of particular budget items, where these items commonly embrace employees‟ salaries, allowances provided to the students, materials requirements, the maintenance costs of the building etc. and annual variation in each budget item is handled independently in accordance to cost projections. The System Dynamics approach that ranges from the qualitative (portrayed in causal loop diagrams, stocks and flows maps) – to the quantitative (represented in equations using mathematical language) research field can be used to investigate the gap

between funding demands and budget allocations. Higher education managers can assign funding to prioritised facilities which directly reflect the quality of education perceived by the student. Institutional strategies seeking the enhancement of the perceived quality (Srikanthan and Dalrymple, 2007; Mamdani, 2007; Try and Grgaard, 2003) and institutional strategies are affected by funding practices (Frølich and Klitkou, 2006; Wabrire, 2007).

The finding of Frances et al (1994), Frances (1995), and Frances (2000) illustrated in section 3.8.3 are consistent with those of Galbraith‟s studies and Barlas and Diker‟s (1996, 2000) as well as Kennedy and Clare (1999). These findings asserted the significance of System Dynamics as a supporting tool for policy change that can enhance quality (as perceived by the student) within a fixed budget. They also agree with the findings of this study.

To recap the aim of this study is to model the dynamics of the Egyptian higher education system in which managers try to raise student satisfaction by improving the quality of education offered This quality improvement is linked to an efficient allocation of resources. The research undertakes a detailed overview of the variables affecting these dynamics and identifies the factors influencing the perceived quality. The inputs to the model are derived from six service facilities which are identified as the major drivers in the budgeting process. Using these inputs as variables, causal models have been constructed to determine an appropriate balance between budget allocation and perceived higher education quality. This model was circulated to resource managers to more than fifty private and public Egyptian universities and was agreed to be broadly correct. A system dynamic model was then constructed that predicted likely outcomes when the budget distribution is changed between these facilities and how this influences the estimated perceived quality to achieve needed quality improvements. The budget expenditure is classified by the effective weight of each facility factor on quality improvement.

There is a need for the Egyptian government to implement a sustainable funding strategy that would support its long-term reform and development objectives. The proposed model could be utilised as a strategic tool to guide the decision makers about the desirable level of public funding, provide possible opportunities for resource diversification, and efficient resources‟ distribution among institutions. As well, private higher education should be expanded to complement public efforts in order to accommodate the enrolment growth. Therefore, the private universities could also implement the proposed modelling tool in order to enhance its

service quality and ultimately the enrichment of the outcome graduates to better satisfy the demands of the labour market.

The suggested model in this study can thus be considered a useful tool to solve a number of items in the higher education system. Those items are as follows: simulating different scenarios for the budgeting allocation considering its long-term effects on the educational system; comparing these effects of various budget assignments on the perceived quality by potential students to find the best strategy for the increase of the perceived quality; and obtaining insights into the factors that are essential for the higher education quality.

8.4 RECOMMENDATIONS

The interaction between budget distribution and the perceived quality of education in higher education is broadly comprehensive. Correspondingly, the recommendations of this research project can be widespread to other developing countries. Universities are inadequately funded and yet ultimately there exists large exponential growth in enrolment rates especially in Public Universities, which undermines its capability not only for improving quality of education but for its sustainability. Thus, prioritising income funding from sources can compensate funding needs in higher education and additionally can represent an immediate solution to maintain perceived quality.

Furthermore, seeking the best strategy for resources allocation in facilities management, in case of Private Universities in particular, at increased but justifiable tuition fees is self-sustaining due to globalisation, for the reason that today‟s indicators of international academic universities‟ standards to can make decisions about whom to employ seek professional expertise and where to study.

Moreover, for perceived quality of education lead to strengthened, governments, major donor institutions, and bilateral organisations must pretend their preparedness to invest in facilities allocation that fulfils the needs of the instantaneous society. Only then will universities be empowered to achieve the dual aim of best facilities funding allocation and resultant perceived quality of education.

8.5 FURTHER RESEARCH

This research aims at modelling the regional behaviour and pinpoints the various service facility factors that influence the quality in higher education in Egypt. Those factors are such

as the pesrons responsible for ranking the educational organisations in relevance to standardization committees. Different facility factors could be resulted if the conducted survey is employed in another environmental context. Accordingly, other recognition of variables and articulation of relationships would have been presented.

Moreover, multiple „What if" scenarios could be generated and the output results could be manipulated in parralel to the required level of estimated perceived quality. Additionally, an enhanced version of the developed model could be produced in a form of Dashboard Screen to act as a process so that any applied modification in the value of service facility factor and its impact on the total measured could be displayed in real time.

REFERENCES

1. AACSB, 1999, *Achieving Quality and Continuous Improvement through Self-Evaluation and Peer Review: Standards for Accreditation*: Business Administration and Accounting, AACSB, St. Louis, MO.
2. Abd Elghany, Mona M., Elharakany, Reem A. (June (2017), "Questioning Facilities Management in Higher Education in Egyptian Context for Better Decision-Making Process of Funding Allocation", *International Journal of Business and Management*, Vol.12, No.7, DOI: 10.5539/ijbm.v12n7p129.
3. Abdelsalam, E.M (2015), "Antecedents and Consequences of Relationship Quality in B2B markets: A case study on a manufacturing Company", *International Journal of customer relationship marketing and management*, IGI publishing, Vol.6, No.1, PP: 35-60.
4. Abdullah, F., (2006), Measuring Service Quality in Higher Education: HEdPERF versus SERVPERF. *Marketing Intelligence and Planning*, 24(1), 31-47. doi:10.1108/02634500610641543
5. Albanese, M., 1999, "*Students are not Customers: A Better Model for Medical Education*", *Academic Medicine*, volume 74, number 11:72-86.
6. Albin, Stephanie, (30 June 1997), Building a System Dynamics Model Part 1: Conceptualization, Massachusetts Institute of Technology MIT System Dynamics in Education Project, Online at: https://ocw.mit.edu/courses/sloan-school-of-management/15-988-system-dynamics-self-study-fall-1998-spring-1999/readings/building.pdf
7. Al-Turki, U. and Duffuaa, S. (2003) Performance Measures for Academic Departments. *International Journal of Educational Management*, 17(7), 330-338. doi:10.1108/09513540310501012
8. Aly, N., and Akpovi, J., (2001), "Total quality management in California public higher education", *Quality Assurance in Education*, Vol. 9, No. 3, pp. 127-31.
9. American International Education Foundation (2004), available at www.uscampus.com.tw/research_options/build_understand/build_article1.htm
10. Andersen, D., Richardson, G. P., (1997a), Group Model Building: Adding More Science to the Craft. System Dynamic Review, 13(2):187–201.
11. Andersen, D., Richardson, G. P., (1997b), Scripts for Group Model Building. System Dynamic Review 13(2):107–129.
12. Arab Republic of Egypt (2004), *The Quality Assurance and Accreditation Handbook for Higher Education in Egypt*. At: http://projects.mans.edu.eg/qaap/iqau/info/Egyptian_NQAAC_Handbook_for_QAA.pdf, last accessed on 20 March 2014.
13. Arab Republic of Egypt (2006), "Law No. 82 for the Year 2006 Regarding the Establishment of the National Authority for Quality Assurance and Accreditation of Education (NAQAAE)". In: *Official Newspaper*, Issue 32 (R), 6 July 2006, p 1-6. Available at: http://naqaae.eg/en/images/pdf/lawn82.pdf, last accessed on 20 March 2014.
14. Arab Republic of Egypt (June 2009). *Implementation Completion and Results Report* (ICR).
15. Arif, M. and Smiley, F. (2004). Baldridge Theory into Practice: a working model. *International Journal of Educational Management*, 18(5), 324-328.
16. Ashworth, A., Harvey, R., (1994), Assessing Further and Higher Education, *Jessica Kingsley publishers*, London.
17. Australia Higher Education Institutions (2000), available at:www.detya.gov.au/highered/statpubs.htm

18. Badri, M. and Abdulla, M. (2004) Awards of Excellence in Institutions of Higher Education: an AHP approach, *International Journal of Educational Management*, 18(4), pp. 224-242.
19. Bagley, J.P., E.R. Foxman, (1997), "*Students as Customers in the Classroom*", Great Ideas for Teaching Marketing, South-Western College Publishing, available at: ,http://www.swcollege.com/marketing/gitm/gitm049.html.
20. Bailey, J.J., B. Dangerfield, 2000, "*Applying the Distinction between Market-Oriented and Customer-Led Strategic Perspectives to Business School Strategy*", *Journal of Education for Business*, pp.183-187.
21. Barlas Y, Diker V.G., (Sept. 2000). A Dynamic Simulation Game (UNIGAME) for Strategic University Management. *Simulation & Gaming*, 31(3), 331-358.
22. Barlas, Y., and Diker, G.D., (1996), „Decision Support for Strategic University Management: A Dynamic Interactive Game", *Proceedings of the 14th International System Dynamics Conference*, Boston, USA.
23. Barnabe, Federico (2004). From Ivory Towers to Learning Organisations: the Role of System Dynamics in the "Managerialization" of Academic Institutions. *Systems Dynamics Conference in 2004.*
24. Barnett, R. (1994) Power, Enlightenment and Quality Evaluation. In *European Journal of Education,* Vol.29 (2) pp.165-179.
25. Becher, T., Embling, J. and Kogan, M. (1978), Systems of Higher Education: United Kingdom, International Council for Educational Development.
26. Becket, N. and Brookes, M. (2006) Evaluating Quality Management in University Departments. *Quality Assurance in Education*, 14(2), 123-142.doi:10.1108/09684880610662015
27. Bell, G., Cooper, M., Kennedy, M., Warwick, J., (2000), The Development of the Holon Planning and Costing Framework for Higher Education Management, *Proceedings of the 18th System Dynamics Conference*, Bergen, Norway.
28. Bentler, P. M., and Bonett. D. G. (1980). Significance tests and goodness of fit in the analysis of covariance structures. *Psychological Bulletin*, 88: 588–606.
29. Berger, P. L., & Luekmann, T. (1967). *The social construction of reality: A treatise in the sociology of knowledge.* Garden City, NJ: Anchor.
30. Berry, L.L., V.A. Zeithaml, and A. Parasuraman, 1985, "*Quality Counts in Services too*", *Business Horizons*, May-June: pp.44-52.
31. Billing, D. (2004), International Comparisons and Trends in External Quality Assurance of Higher Education: commonality or diversity? *Higher Education,* 47, pp. 113–137.
32. Birnbaum, R. & Deshotels, J. (1999), Has the Academy Adopted TQM? *Planning for Higher Education,* Vol.28*,* pp. 29-37.
33. Birnbaum, R. (2000), *Management Fads in Higher Education*. San Francisco: Jossey- Bass
34. Bon, R., McMahan, J. F., & Carder, P. (1994). Property Performance Measurement: From Theory to Management Practice. *Facilities*, Vol. 12 (No. 12), pp. 18-24.
35. Borahan, N. G. and Ziarati, R. (2002) Developing Quality Criteria for Application in the Higher Education Sector in Turkey. *Total Quality Management*, 13(7), 913-926.
36. Bowden, J.A. and Marton, F. (1998), The University of Learning: Beyond Quality and Competence in Higher Education, Kogan Page, London.

37. Bradbery, P. (1991) The Process is the Content. In Atkinson, R. and McBeath, C. (eds.) *Quality in Distance Education: ASPESA Forum 1991,* , Bathurst, (AUS), 387-397
38. Brennan, J. & Shah, T. (2000), *Managing Quality in Higher Education. An international perspective on institutional assessment and change.* Buckingham: Open University Press
39. Brennan, J., Fedrowitz, J., Huber, M. and Shah, T. (Eds) (1999), What Kind of University? International Perspectives on Knowledge, Participation and Governance, The Society for Research into Higher Education and Open University Press, Buckingham.
40. Brislin, R. W. (1980). Translation and Content Analysis of Oral and Written Material. In Triandis, H. C. and Berry, J. W. (eds.). Handbook of Cross-Cultural Psychology. Vol. 2: Methodology. Boston: Allyn and Bacon.
41. Brookes, M. and Becket, N. (2007) Quality Management in Higher Education: a review of international issues and practice. *International Journal of Quality and Standards*, Paper 3, 1(1).
42. Brookes, M. and Becket, N. (2008) Quality Management Practice in Higher Education – What Quality Are We Actually Enhancing? Journal of Hospitality, Leisure, Sport and Tourism Education doi:10.3794/johlste.71.174
43. Browne, M. W., and Cudeck. R., (1993). Alternative ways of assessing model fit. In: Testing structural equation models, K.A. Bollen and J. S. Long, eds. Newbury Park, CA: Sage Publications, 136–162.
44. Bryman, A. (2004), Social Research Methods, New York, Oxford University Press, Inc.
45. Calvo-Mora, A., Leal, A. and Roldan, J., (2006), Using Enablers of the EFQM Model to Manage Institutions of Higher Education, *Quality Assurance in Education*, 14(2), 99-122.
46. Campbell, D. T., & Stanley, J. C. (1963). Experimental and quasi-experimental designs for research. Chicago: Rand McNally.
47. Carmines, E. G., and J. P. McIver, (1981). Analyzing models with unobserved variables. In: Social measurement: Current issues, G. W. Bohrnstedt and E. F. Borgatta, eds. Beverly Hills: Sage Publications.
48. Charles Emery, Tracy Kramer and Robert Tian, 2001, "*Customers vs. Products: Adopting an Effective Approach to Business Students*", *Quality Assurance in Education,* Volume 9, Number 2,:110-115.
49. Charmaz, K. (2006). *Constructing grounded theory.* Thousand Oaks, CA: Sage.
50. Chase, R.B. and Acquilano, N.J., *Production and Operations Management: A Life Cycle Approach,* Irwin, Homewood, IL, 1992.
51. Checkland, P., Scholes, J., (1998), Soft Systems Methodology in Action, Wiley, Chichester.
52. Chen, H.C. (1997), University Evaluation, Wu-Nan Bookstore, Taipei.
53. Chen, S., Yang, C. and Shiau, J. (2006) The Application of a Balanced Scorecard in the Performance Evaluation of Higher Education. *TQM Magazine*, 18(2), 190-205.
54. Cheng, Y and Tam, W (1997) Multi-Models of Quality in Education. *Quality Assurance in Education*, 5(1), 22-31. doi:10.1108/09684889710156558
55. Cherryholmes, C. H. (1992, August–September), Notes on pragmatism and scientific realism. *Educational Researcher*, 14, pp. 13–17.
56. Chian, F.M. and Lee, C.M. (2001), Development and Framework of National Education Indicator System: Modern Education Indicators, Hsue-Fu Culture, Taipei.

57. Clandinin, D. J., & Connelly, F. M. (2000). *Narrative inquiry: Experience and story in qualitative research.* San Francisco: Jossey-Bass.
58. Clare, C., (1995). Introducing TQM in a new university: Practical lessons. In G. K. Kanji (Ed.). *Total quality management. Proceedings of the first world congress*. London: Chapman and Hall.
59. Cochran Judith, (1986), *Education in Egypt*, Croom Helm.
60. Conti, T. (1999), Vision 2000: positioning the new ISO 9000 standards with respect to total quality management models. *Total Quality Management*, 10, pp. 454-464.
61. Corbin, J. M., & Strauss, J. M. (2007). *Basics of qualitative research: Techniques and procedures for developing grounded theory* (3rd ed.). Thousand Oaks, CA: Sage.
62. Creswell, J. W. (2012). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research* (4th ed.). Upper Saddle River, NJ: Merrill.
63. Creswell, J. W., & Plano Clark, V. L. (2011). *Designing and conducting mixed methods research* (2nd ed.). Thousand Oaks, CA: Sage.
64. Creswell, John W., (2014). *Research Design_ Qualitative, Quantitative, and Mixed Methods Approaches*. SAGE Publications, Fourth Edition.
65. Cronin Jr, J. J., & Taylor, S. A. (1994). SERVPERF versus SERVQUAL: Reconciling performance-based and perceptions-minus-expectations measurement of service quality. The Journal of Marketing, 125-131. Retrieved from http://www.jstor.org/stable/1252256
66. Crotty, M., (1998). *The foundations of social research: Meaning and perspective in the research process*. Thousand Oaks, CA: Sage.
67. Cullen, J., Joyce, J., Hassall, T. and Broadbent, M., (2003). Quality in Higher Education: from monitoring to management. *Quality Assurance in Education*, 11(1), 5-14.
68. Cunliffe, A. L., (2009). *A very short, fairly interesting and reasonably cheap book about management. London*: SAGE.
69. CVCP/UGC (1987), University Management Statistics and Performance Indicators: UK Universities, University Statistics Records, London.
70. D"Andrea, V.-M. (2000), *Educational Development Centre Annual Report: 1998-1999*. University of Surrey, Roehampton.
71. DAAD (German Academic Exchange Service). 2012. *Looking Ahead: Higher Education's Transition in Egypt and Tunisia.* At: https://www.daad.de/medien/hochschulen/regional/arabien/transformation/en-tunisia-egypt.pdf (Accessed on May 10, 2015)
72. Dahlan S. F. M., Yahaya N. A. (2010). A System Dynamics Model for Determining Educational Capacity of Higher Education Institutions. *Computational Intelligence, Modelling and Simulation (CIMSiM 2010) Second International Conference.*Bali, Indonesia.
73. Daigneau, William A., (2005), "Planning, Designing and Managing Higher Education Institutions"; OECD Publishing.
74. Dale, Roger (Winter 2007). "Changing Meanings of „the Europe of Knowledge" and „Modernizing the University." From Bologna to the „New Lisbon"." In: European Education, Vol. 39, No. 4, p. 27-42.
75. Dart, B. and Boulton-Lewis, G. (Eds) (1998), Teaching and Learning in Higher Education, Australian Council for Educational Research, Melbourne.

76. De Vaus, D.A., (2002), Surveys in Social Research, 5th Ed, London, Routledge.
77. Deming, W. E. (1993) *The New Economics for Industry, Government, Education*. Cambridge, MA: Massachusetts Institute for Technology, Centre for Advanced Engineering Study.
78. Deming, W. E., (1986), Out of the Crisis (Cambridge, MA, Massachusetts Institute of Technology, Centre for Advanced Engineering Study).
79. Dill, D.D. (1992), Quality by Design: toward a framework for academic quality management. In Smart, J.C. (Ed.), *Higher Education: handbook of theory and research*. Vol. VIII., New York: Agathon Press.
80. Dill, D.D. (1995), Through Deming"s Eyes: a cross-national analysis of quality assurance policies in higher education. *Quality in Higher Education*, Vol.1, pp. 95-110.
81. Dill, David, (4th and 5th July 2011), Higher Education as a Public Good: Critical Perspectives New College, Oxford, Online at http://www.srhe.ac.uk/downloads/TN-dl-Dill-050711.pdf
82. Donald, J.G. (1984), "Quality indicator for faculty evaluation", *Assessment and Evaluation in Higher Education,* Vol. 9, pp. 41-52.
83. Duke, C. (1992), The Learning University: Towards a New Paradigm?, The Society for Research into Higher Education and Open University Press, Buckingham.
84. EACEA. 2012a. *Overview of the Higher Education System in Egypt*. http://eacea.ec.europa.eu/tempus/participating_countries/overview/egypt_tempus_country_fiche_final.pdf (Accessed on May 12, 2015).
85. EACEA. 2012b. *Brief summary of Tempus impact study in* Egypt. http://eacea.ec.europa.eu/tempus/participating_countries/impact/egypt.pdf (Accessed on May 12, 2015)
86. El-Kot, G. A. H., (2001) Team Player Styles, Team Design Variables and Team Work Effectiveness in Egypt. A Thesis Submitted in partial fulfilment of the Requirements of the University of Plymouth for the Degree of Doctor of Philosophy. Plymouth: University of Plymouth.
87. El-Sahen, M. F., (1994), "The perception of Service Quality in The Banking Sector: An empirical study for testing the determinants and models used in measuring it", pp. 1-37, Faculty of Commerce Magazine, Alexandria, Egypt.
88. El-Sahen, M. F., (1995), "Management of service quality: studying the factors that Influence in determining the perceptual service quality by using SERVQUAL method", pp. 1-67, Faculty of Commerce Magazine, Alexandria, Egypt.
89. El-Sayed, I. M., (1997), "Segmenting the banking service industry by using the service quality dimensions as a way for market segmentation based on values and profit", pp.1-36, Faculty of Commerce Magazine, Alexandria, Egypt.
90. El-Sayed, I. M., (1998), Research Methods for Business, El-Dar El-Gameeya, Alexandria, Egypt.
91. El-Sayed, I. M., (1998), "The Influence of some factors of service on the various perception levels in hotels", pp. 1-63, Faculty of Commerce Magazine, Alexandria, Egypt.
92. Enaohwo, J. O., (10th – 15th November 2003), Strategies for achieving and maintaining quality assurance in education, Paper presented at *the 18th Annual Congress of the Nigerian Academy of Education*, Uniport, Nebula 5(4), 211-223.
93. European Commission. (2012). *State of Play of the Bologna Process in the Tempus Partner Countries*, a Tempus Study, Issue Number (9). Available online at:

http://eacea.ec.europa.eu/tempus/tools/documents/issue09_Bologna_state_play_120720_en.pdf (Accessed on May 10, 2015)

94. European Foundation for Quality Management, (2003), Modelo EFQM de Excelencia, European Foundation for Quality Management, Brussels.
95. Fetterman, D. M. (2010). *Ethnography: Step by step* (3rd ed.). Thousand Oaks, CA: Sage.
96. Ford, J., Joseph, M. and Joseph, B. (1999) Importance-Performance Analysis as a Strategic Tool for Service Marketers: the case of service quality perceptions of business students in New Zealand and the USA. Journal of Services Marketing, 13(2), 171-186. doi:10.1108/08876049910266068
97. Forrester, Jay, (Jan. 1971), „Counterintuitive behavior of social systems", *Technology Review*, Vol. 73, No. 3, pp. 52-68.
98. Forrester, J.W., (1994). Policies, Decisions, and Information Sources For Modelling. In Morecroft, J.D.W., and Sterman, J.D. (eds). *Modelling for Learning Organisations*, Productivity Press, Portland, USA.
99. Forrester, J. W., (15 December 1998). *Designing the future*. At Universidad de Seville, Seville, Spain.
100. Fowler, F. J., (2009). *Survey research methods* (4th ed.). Thousand Oaks, CA: Sage.
101. Frances, C., (1995), Using System Dynamics Technology to Improve Planning for Human Resource Development, *Presentation at the Congress of Political Economists, International 6th Annual Conference*, Seoul, Korea.
102. Frances, C., (2000), Using System Dynamics as a Tool for Decision Making in Higher Education Management- U.S. Experience, in Kennedy, M. (ed). (2000). Selected papers presented at an international seminar on „Using System Dynamics as a Tool for Decision Making in Higher Education Management" held in June 1999 at the Royal Society, London and South Bank University, under the auspices of the Society for Research into Higher Education, *South Bank University Technical Report SBU-CISM-12-00,* London UK.
103. Frances, C., Van Alstyne, M., Ashton, A., and Hochstettler , T., (1994), Using System Dynamics Technology to Improve Planning Higher Education: Results in Arizona and Houston, Texas, *In Proceedings of the 13th International System Dynamics Conference*, Stirling, Scotland, pp. 444-453.
104. Frazer, M. (1997), Report on the Modalities of External Evaluation of Higher Education in Europe: 1995-97. *Higher Education in Europe*, 22, pp. 349-401.
105. Frølich, N., and Klitkou, A., (2006), Strategic management of higher education institutions: performance funding and research output. Paper presented at the Conference on Indicators on Science, Technology and Innovation, Special session on Indicators for strategic management of higher education institutions, November 15-17, in Lugano, Switzerland.
106. Galbraith, P.L., (1982), Forecasting Futures for Higher Education in Australia: An Application of Dynamic Modelling. *Ph.D. Thesis*, The University of Queensland.
107. Galbraith, P.L., (1989), Strategies for Institutional Resource Allocation: Insights from a Dynamic Model, *Higher Education Policy*, Vol. 2 (2), pp 31-38.
108. Galbraith, P.L., (1998a), When Strategic Plans are not Enough: Challenges in University Management*, System Dynamics: An International Journal of Policy Modelling*, X (1 and 2), pp 55-84.
109. Galbraith, P.L., (1998b), System Dynamics and University Management*, System Dynamics Review*, Vol. 10 (2), pp 69-84.

110. Galbraith, P.L., and Carss, B.W., (1989), „Strategies for Institutional Resource Allocation: Insights from a Dynamic Model", *Higher Education Policy*, Vol. 2(2), pp. 31-36.
111. Garvin, D. A. (1987). Competing on eight dimensions of quality. Harvard Business Review, 65(6), 101–109.
112. Garvin, D.A. (1988), Managing quality – the strategic and competitive edge. New York, Free Press
113. Geoffrey N. Soutar, Julia P. Turner, 2002, "Students' Preferences for University: a Conjoint Analysis", The International Journal of Educational Management, Volume 16, Number 1, :40-45.
114. Gerson R. F. (1993). Measuring customer satisfaction*: A guide to managing quality service*. Menlo Park: Crisp Publications.
115. Ghaffarzadegan, N., Hawley, J., Desai, A., (2014), „Research workforce diversity: The case of balancing national versus international postdocs in US Biomedical research", *Systems research and behavioral science*, Vol. 31(2): pp.301–315.
116. Ghauri, P. and Grønhaug, K., (2002), Research Methods in Business Studies: A Practical Guide, 2nd Ed, Harlow, Financial Times, Prentice Hall.
117. Glaser, B. G., Strauss, A. L., (1967), The Discovery of Grounded Theory: Strategies for Qualitative Research, Aldine, Chicago.
118. Goldstein, P. J., (2006), *The Future of Higher Education: A View from CHEMA*, Council of Higher Education Management Associations, Washington, DC., *www.appa.org/fi les/pdfs/appa39a_screenopt.pdf*.
119. Gordon, G. and Partington, P., *Quality in Higher Education: Overview and Update*, USDU Briefing Paper No. 3, USDU, Sheffield, 1993.
120. Gornitzka, A, & Maasen, P. (2000), The Economy, Higher Education, and European integration: an Introduction, *Higher Education Policy*, 13, pp. 217-223.
121. Gosling, D. & D"Andrea, V.- M. (2001), Quality Development: a new concept for higher education. *Quality in Higher Education*, 7, pp. 7- 17.
122. Grant, D., Mergen, E. & Widrick, S. (2004), A Comparative Analysis of Quality Management in US and International Universities. *Total Quality Management*, 15, pp. 423-438.
123. Grant, D., Mergen, E. and Widrick, S. (2002) Quality Management in US Higher Education. *Total Quality Management*, 13(2), 207-215
124. Green, D., (1994), *What is Quality in Higher Education*, St. Edmundsbury Press.
125. Greene, J. C., (2007). *Mixed methods in social inquiry*. New York: Wiley.
126. Guba, E. G., (1990). *The alternative paradigm dialog*. SAGE Publications.
127. Gwynne, A. L., Devlin, J. F., & Ennew, C. T. (2000). The zone of tolerance: insights and influences. *Journal of Marketing Management*, *16*(6), 545-564. http://dx.doi.org/10.1362/026725700785045921
128. Hai, Pham Van, and Esichaikul, Vatcharaporn, (2008), A web-based decision support system for the evaluation and strategic planning using ISO 9000 factors in higher education, *VNU Journal of Science*, Mathematics - Physics 24, PP. 197-208, Online at: http://tapchi.vnu.edu.vn/tl_4_08/hai.pdf
129. Hanaysha, J., Abdullah, H. H., & Warokka, A. (2011). Service quality and students" satisfaction at higher learning institutions: The competing dimensions of Malaysian Universities" competitiveness. *Journal of Southeast Asian Research*, *1*. http://dx.doi.org/10.5171/2011.855931

130. Hanneman, R. A (1988), Computer-Assisted Theory Building. Modelling Dynamic Social Systems. *SAGE Publications*, Newbury ParkLane and Oliva.
131. Harris, J.W., & Baggett, J.M., (1992), Quality Quest in the Academic Process, Samford University, Birmingham, AL, and GOAL/QPC, Methuen, MA.
132. Harvey, L. (1995), Quality Assurance Systems, TQM, and the New Collegialism, Centre for Research into Quality, University of Central England, Birmingham, p. 66.
133. Harvey, L. (2002). Quality assurance in higher education: some international trends. *Higher Education Conference*, Oslo, pp. 22–23.
134. Harvey, L. and Knight, P. T., (1996), Transforming Higher Education, The Society for Research into Higher Education and Open University Press, Buckingham.
135. Harvey, Lee, and Green, Diana., (1993), Defining Quality. In Assessment and Evaluation in Higher Education, Publisher Routledge, Volume 18, Issue (1), PP. 9-34. Available online at: https://www.tandfonline.com/doi/abs/10.1080/0260293930180102
136. Hassan, K. El., (2013), Quality assurance in higher education in 20 MENA economies, *Higher Education Management and Policy*, Vol. 24/2.
137. Haworth, J.G., and Conrad, C.F., (1997), Emblems of Quality in Higher Education: Developing and Sustaining High-Quality Programs, Allyn & Bacon, Longwood Division, Needham Heights, MA.
138. Hewitt, F., and Clayton, M., (1999), Quality and Complexity – lessons from English higher education, *International Journal of Quality & Reliability Management*, 16 (9), 838-858.
139. Hides, M., Davies, J., and Jackson, S., (2004), Implementation of EFQM Excellence Model self – assessment in the UK Higher Education Sector – lessons learned from other sectors. *TQM magazine,* 16(3), 194-201. doi:10.1108/09544780410532936.
140. Higher Education Quality Council, (1995), *Graduate Standards Programme Interim Report*, London: HEQC.
141. Hopper, M., & Stave, K. A. (2008). Assessing the Effectiveness of Systems Thinking Interventions in the Classroom in *The 26th International Conference of the System Dynamics Society*. Athens, Greece, pp. 1-26.
142. http://www.capmas.gov.eg/Pages/IndicatorsPage.aspx?page_id=6142&ind_id=1082
143. http://www.frcu.eg/www.supreme.html.
144. http://www.topuniversities.com/qs-world-university-rankings
145. http://www.topuniversities.com/where-to-study/africa/egypt/guide
146. http://en.wikipedia.org/wiki/Al-Azhar_University
147. https://en.wikipedia.org/wiki/Education_in_Egypt#Demogr
148. Hui, C. H., & Triandias, H. C., (1985), Measurement in cross-cultural psychology: a review and comparison of strategies, *Journal of Cross-Cultural Psychology,* 16 (2), pp.131-152.
149. Hur, H., Ghaffarzadegan, N., Hawley, J., (2015), „Effects of Government Spending on Research Workforce Development: Evidence from Biomedical Postdoctoral Researchers", *PLoS ONE 2015*; 10(5).
150. Hussein, Sherif, (2010). Education Quality Control Based on System Dynamics and Evolutionary Computation, *Modelling Simulation and Optimization - Focus on Applications*, Shkelzen Cakaj (Ed.), InTech, DOI: 10. 5772/8963.

151. Hussein, Sherif, (2013), Education Quality Control Based on System Dynamics and Evolutionary Computation, *Modelling Simulation and Optimization Focus on Applications Open Access eBook Edited by Shkelzen Cakaj Chapter 18*, Available online at: http://www.intechopen.com/books/modeling-simulation-and-optimization-focus-on-applications/education-quality-control-based-on-system-dynamics-and-evolutionary-computation.

152. Hwarng, H., and Teo, C., (2001), Translating Customers‟ Voices into Operational Requirements – a QFD application in higher education, *International Journal of Quality & Reliability Management*, 18(2), 195-225.

153. Jaramillo, Adriana and Hafedh Zaafrane, (2014), Benchmarking university governance in the MENA region, *Higher Education Management and Policy*, vol. 24/3, OECD.

154. Jaramillo, Adriana and Thomas Melonia (eds.). 2011. *Breaking even or breaking through: reaching financial sustainability while providing high quality standards in Higher Education in the Middle East and North Africa*, World Bank report no. 65054, working paper.

155. Jennifer E. Rowley, (1996). Customer compatibility management: an alternative perspective on student-to-student support in higher education, International Journal of Educational Management 10/4 [1996] 15–20.

156. JENS J. DAHLGAARD - PEDER ØSTERGAARD, 2000, "*TQM and Lean Thinking in Higher Education*", *sinergie rapporti di ricerca n. 9.*

157. Jick, T. D., (December 1979), Mixing qualitative and quantitative methods: Triangulation in action, *Administrative Science Quarterly, 24,* 602–611.

158. Johnes, J. and Taylor, J. (1990), *Performance Indicators in Higher Education: Buckingham,* The Society for Research into Higher Education & Open University, Buckingham.

159. Johnson, R. B., & Onwuegbuzie, A. J. (2004). Mixed methods research: A research paradigm whose time has come. *Educational Researcher*, 33, pp. 14–26.

160. Johnson, R. B., & Turner, L. A. (2003). Data collection strategies in mixed methods research. In A. Tashakkori & C. Teddlie (Eds.), *Handbook of mixed methods in social and behavioral research* (pp. 297–319). Thousand Oaks, CA: Sage.

161. Jones, R., 1997, "*Kids as Education Customers*", *Education Digest*, volume 62, number 5, pp:10-16.

162. Jöreskog, K. G., and D. Sörbom. 1984. LISREL-VI user‟s guide. 3rd ed. Mooresville, IN:Scientific Software.

163. Kanji, G.K., (1998), Measurement of Business Excellence, *Total Quality Management*, 9, pp. 633-643

164. Kanji, G.K., (2001), Forces of Excellence in Kanji‟s Business Excellence Model. *Total Quality Management*, 12, pp. 259-272.

165. Kanji, G.K., Malek, A. and Tambi, A. (1999), “Total quality management in UK higher education institutions”, *Total Quality Management*, Vol. 10, No. 1, pp. 129-53.

166. Kanji, G.K., Tambi, A.M.A. & Wallace, W. (1999), A Comparative Study of Quality Practices in Higher Education Institutions in the US and Malaysia. *Total Quality Management*, 10, pp. 357-371.

167. Kaplan, R.S., and Norton, D.P. (1992), “The balanced scorecard measures that drive performance”, *Harvard Business Review*, Vol. 70, pp. 71-9.

168. Kaplan, R.S., and Norton, D.P., (1996a), “Linking the balanced scorecard to strategy”, *California Management Review*, Vol. 39, No. 1, pp. 53-79.

169. Kaplan, R.S., and Norton, D.P., (1996b), „The Balanced Scorecard: Translating Strategy into Action", *Harvard Business School Press*, Boston, MA.
170. Kaplan, R.S. and Norton, D.P., (2001a), The Strategy-Focused Organisation: How Balanced Scorecard Companies Thrive in the New Business Environment, *Harvard Business School Press*, Boston, MA.
171. Kaplan, R.S. and Norton, D.P., (2001b), "Transforming the balanced scorecard from performance measurement to strategic management: Part I", *Accounting Horizons*, Vol. 15, No. 1, pp. 87-104.
172. Kaplan, R.S. and Norton, D.P., (2001c), "Transforming the balanced scorecard from performance measurement to strategic management: Part II", *Accounting Horizons*, Vol. 15, No. 2, pp. 147-60.
173. Kemmis, S., & Wilkinson, M. (1998). Participatory action research and the study of practice. In B. Atweh, S. Kemmis, & P. Weeks (Eds.), Action research in practice: Partnerships for social justice in education (pp.21–36). New York: Routledge.
174. Kennedy, M., (1997a), Transforming Spreadsheets into System Dynamics Models, *Proceedings of l5th System Dynamics Conference*, Istanbul, Turkey.
175. Kennedy, M., (1997b). The transformation of a Power Plant Investment Appraisal Application from a Spreadsheets into a System Dynamics Model, *Proceedings of l5th System Dynamics Conference*, Istanbul, Turkey.
176. Kennedy, M., (1998). A Pilot System Dynamics Model to Capture and Monitor Quality Issues in Higher Education Institutions Experiences Gained. In *Proceedings of the 16th System Dynamics Conference, Quebec City, Canada* (p. 7).
177. Kennedy, M., (2002), An Extended Taxonomy of System Dynamics Models of Higher Education. Paper presented at the *twentieth international conference of the System Dynamics Society*, Italy July 28- August 1, in Palermo, Italy.
178. Kennedy, M., (2009). A Review of System Dynamics Models of Educational Policy Issues. *The 2009 International Conference of the System Dynamics Society*. Albuquerque, NM.
179. Kennedy, M., and Clare, C., (1999), Some Issues in Building System Dynamics Model for Improving the Resource Management Process in Higher Education, *In Proceedings of the 17th International System Dynamics Conference*, Wellington, New Zealand.
180. Kennedy, M. and Clare, C., (2003), A Comparison of the Application of Performance Indicators, System Dynamics Models and the Holon Framework to Quality Assessment in Higher Education, *In Proceedings of the 21st International System Dynamics Conference*, New York, USA.
181. Kivimaki, M., Kuk, G., Elovainis, M., Thomson, L., Kalliomaki-Levanto, T. & Heikkila, A., (1997), The climate inventory (TCI) four or five factors? Testing the structure of TCI in sample of low and high complexity jobs, *Journal of Occupational and Organisational Psychology*, 70, pp.375-389.
182. Kline, R. B., (2005). Principles and Practice of Structural Equation Modelling. New York: The Guilford Press.
183. Knirk, F.G., (1992). "Facility Requirements for Integrated learning system". Educational Technology, Vol. 32 No. 9, PP. 26-32.
184. Kotler, P. (1985), *Strategic Marketing for Educational Institutions*, Prentice-Hall, London
185. Králiková, Katarína and Hanan Rezk. 2012. *Ideas to Actions: A Springeneration for EU–MENA Cooperation in Education.* Center for European Studies, Brussels.

http://www.martenscentre.eu/sites/default/files/publication-files/springenerationpaper.pdf (Accessed on May 18, 2015)

186. Kwan, P., and Ng, P. (1999), Quality Indicators in Higher Education – comparing Hong Kong and China"s students. *Managerial Accounting Journal*, 14(1,2), 20-27.

187. LaGraffe, Daniel, (2012), The Youth Bulge in Egypt: An Intersection of Demographics, Security, and the Arab Spring, *Journal of Strategic Security* 5(2).

188. Larson R.C., Gomez Diaz M., (2012), „Nonfixed retirement age for university professors: modeling its effects on new faculty hires", *Service science*, vol. 4(1): pp. 69–78.

189. Lawrence, J. and McCollough, M. (2001) A Conceptual Framework for Guaranteeing Higher Education. *Quality Assurance in Education*, 9(3), 139-152.

190. Leigh-Smith, B. and McCann, J. (Eds) (2001), *Reinventing Ourselves: Interdisciplinary Education, Collaborative Learning, and Experimentation in Higher Education*, Anker Publishing Company, Boston, MA.

191. Lewis, L. S., & Altbach, P.G., (1996), Faculty Versus Administration: A Universal Problem, *Higher Education Policy,* Vol. 9, No. 3, pp 255-258.

192. Lin, B., (1993), "Application of total quality management on the campus", *Training for Quality,* Vol. 1 No. 3, pp. 34-8.

193. Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. Newbury Park, CA: Sage.

194. Lincoln, Y. S., Lynham, S. A., & Guba, E. G. (2011). Paradigmatic controversies, contradictions, and emerging confluences revisited. In N. K. Denzin & Y. S. Lincoln, *The SAGE handbook of qualitative research (4th ed.)*, pp. 97–128. Thousand Oaks, CA: Sage.

195. Lucas, A.F. et al. (2000), *Leading Academic Change: Essential Roles for Department Chairs*, Jossey-Bass, San Francisco, CA.

196. Luckett, K. (2005) A Critical Policy Analysis of the Proposed National Quality Assurance System for South African Higher Education. In Smout, M. (ed) *The Decade Ahead: Challenges for Quality Assurance in South African Higher Education*, SAUVCA, Pretoria

197. Luna-Reyes, F.P., and Anderson, D.L. 2003. Collecting and Analyzing Qualitative Data for System Dynamics: Methods and Models, *System Dynamics Review 19*: pp. 271-296.

198. Mackintosh, M., Jarvis, R., & Henry, E., (Nov 1994), "On Managing Hybrids: Some Dilemmas in Higher Education Management." *Financial Management & Accountability*, 10 (4), pp. 339-353.

199. Maier, F., & Meyer, M. (2011). Managerialism and Beyond: Discourses of Civil Society Organisation and Their Governance Implications. *Voluntas*, 22, 4.

200. Makhanya, M. S., (18 – 22 October 2010), The final words: Making the best of facilities management in the higher education environment, *Higher Education Facilities Management (HEFMA) Conference 2010*, Theme: Facilities Management in 2010 – Opportunities for Improvement, Alpine Heath Resort, Northern Drakensberg.

201. Mamdani, M., (2007), *Scholars in the marketplace: The dilemmas of neo-liberal reform at Makerere University 1989-2005,* Kampala: Fountain Publishers.

202. Mansmann, Svetlana, and Scholl, Marc H. , (May 2007), Decision Support System for Managing Educational Capacity Utilization, *IEEE TRANSACTIONS ON EDUCATION*, Vol. 50, No. 2, PP. 143-150, Available online at: https://www.uni-konstanz.de/mmsp/pubsys/publishedFiles/MaSc07.pdf
203. Maria Tsinidou , (2010) Evaluation of the factors that determine quality in higher education: an empirical study. *Quality Assurance in Education*. Vol. 18 No. 3, pp. 227-244.
204. Markovic, S., (2006), Expected Service Quality Measurement in Tourism Higher Education. *Pregledni Znansteveni Clanki Review Papers*, 1(2), 86-95.
205. Marmolejo, Francisco, (2007), "Higher Education Facilities: Issues and Trends", University of Arizona, United States.
206. Martens, E. and Prosser, M. (1998), What Constitutes High Quality Teaching and Learning and How to Assure It. *Quality Assurance in Education*, 6(1), 28-36. doi:10.1108/09684889810200368
207. Massy, W.F., (1997), Teaching and Learning Quality-process Review: the Hong Kong programme. *Quality in Higher Education*. 3, pp. 249-262.
208. Massy, W.F., (2003), *Honoring the Trust: quality and cost containment in higher education*. Bolton, Massachusetts: Anker Publishing.
209. MBNAQ, (2004), available at: www.usnews.com/usnews/edu/eduhome.htm
210. McAdam, R. and Welsh, W., (2000) A Critical Review of the Business Excellence Quality Model Applied to Further Education Colleges. *Quality Assurance in Education*, 8(3), 120-130. doi:10.1108/09684880010372716
211. Mergen, E., Grant, D. & Widrick, S.M., (2000), Quality Management Applied to Higher Education. *Total Quality Management*, 11, pp. 345-352.
212. Mertens, D. (2009). *Transformative research and evaluation*. New York: Guilford.
213. Mertens, D M., (September 2010). *A Book Review. Research and Evaluation in Education and Psychology (3rd ed.)* The Qualitative Report, Volume 15, Number 5, pp. 1304-1305. http://www.nova.edu/ssss/QR/QR15-5/mertens.pdf
214. Merton, R. K., (1968), Social theory and social structure, enlarged edn. Free Press, New York.
215. Michael, S.O., (1998), "Restructuring US higher education: analyzing models for academic program review and discontinuation", Association for the Study of Higher Education, Vol. 21 No. 4, pp. 377-404.
216. Middlehurst, R., and Gordon, G., (1995), "Leadership, quality and institutional effectiveness", *Higher Education Quarterly*, Vol. 49, No. 3, pp. 267-85.
217. Mikulskiene B, Mazrimiene D., (2013), „Transformative quality of doctoral education: the way new standards are negotiated, System dynamics approach", *In Proceedings of the 31th International Conference of the System Dynamics Society.*
218. Ministry of Education Report 2007.
219. Mitchell, P. (Ed.) (1998), *Beyond the Universities: The New Higher Education, Monitoring Change in Education*, Ashgate Publishing House, Aldershot.
220. Mizikaci, F., (2006), A Systems Approach to Programme Evaluation Model for Quality in Higher Education. *Quality Assurance in Education*, 14(1), 37-53.
221. MOE Highest Commander, (2003), "University evaluation", available at: www.high.edu.tw/01/01.htm

222. Ministry of Higher Education (MoHE) (2012), *The Development of Education in Egypt, 2007–2012: A National Report*, Cairo: Ministry of Higher Education.

223. Moraru, L. (2012). Academic internal stakeholder condition: a comparative approach. *Procedia-Social and Behavioral Sciences*, *69*, 54-72. http://dx.doi.org/10.1016/j.sbspro.2012.11.383

224. Morgan, D. L., (2007), Paradigms lost and pragmatism regained: Methodological implications of combining qualitative and quantitative methods, *Journal of Mixed Methods Research*, 1, 48–76.

225. Morse, R.J. and Flanigan, S.M., (2002), "How we rank schools", US News & World Reports, available at: www.usnews.com/usnews/edu/college/rankings/about/02cbrank.htm (accessed January 23, 2002).

226. Motwani, J., and Kumar, A., (1997), The Need for Implementing Total Quality Management in Education. *International Journal of Educational Management*, 11(3), 131-135.

227. Moustakas, C., (1994). *Phenomenological research methods.* Thousand Oaks, CA: Sage.

228. Murphy, J. P., (1990). *Pragmatism: From Peirce to Davidson.* Boulder, CO: Westview.

229. Myers, K. & Ashkenas, R. (1993), Results-driven Quality. *Executive Excellence*, 10, pp. 17.

230. Neubauer, D. (2008), „US higher education accreditation old and new: the emergence of a new paradigm", in *Evaluation in Higher Education*, Vol 2, No 2, Dec, Higher Education Evaluation and Accreditation Council of Taiwan.

231. Neuman, S. B., & McCormick, S. (Eds.). (1995). *Single-subject experimental research: Applications for literacy.* Newark, DE: International Reading Association.

232. Neuman, W. L. (2009). *Social research methods: Qualitative and quantitative approaches* (7th ed.). Boston: Allyn & Bacon.

233. Newmark, P., (1988). Approaches to Translation. 2nd Ed. New York: Prentice-Hall International.

234. Newton, J., (2002), Barriers to Effective Quality Management and Leadership: case study of two academic departments. *Higher Education*, 44, pp. 185-212.

235. Niven, P.R. (2002), *Balanced Scorecard Step by Step*, Wiley, New York, NY.

236. Notturno, F.L., (1997), "*Students as products*", Great Ideas for Teaching Marketing, South-Western College Publishing, Cincinnati, OH.

237. Oakland, J.S. (1990), *Total Quality Management*, Heinemann Professional Publishing, Melksham.

238. Osseo-Asare Jr, A., and Longbottom, J., (2002), The Need for Education and Training in the Use of the EFQM Model for Quality Management in UK Higher Education Institutions, *Quality Assurance in Education*, 10(1), 26-36. doi:10.1108/09684880210416085

239. Owlia, M., and Aspinwall, E., (1996), A Framework for the Dimensions of Quality in Higher Education, *Quality Assurance in Education*, 4(2), 12-20. doi:10.1108/09684889610116012

240. Oxford Dictionary of Sociology (1998), A dictionary of sociology, 2nd edn. In: Marshall G (ed) Oxford University Press, Oxford.

241. Oyo, B., Williams, D., and Barendsen, E., (2008). A System Dynamics Tool For Higher Education Funding And Quality Policy Analysis. *In Proceedings of the 24th International Conference of the System Dynamics Society.*

242. PA Consulting Group, (1990), *The Total Quality Experience: A Guide for the Continuing Journey*, PA Consulting Group, London.

243. Palaima, T., & Auruskeviciene, V., (2007), Modeling relationship quality in the parcel delivery services market, *Baltic Journal of Management*, 2 (1), pp. 37-54.

244. Parasuraman, A., V. Zeithaml, and L. Berry, 1988, ″SERVQUAL: a multiple-item scale for measuring consumer perceptions of service quality*″, Journal of Retailing,* Volume 64, :12-40.

245. Parri, J., (2006), "Quality in higher education", *Vadyba/Management*, Vol. 2 No. 11, pp. 107-11.

246. Patton, M. Q., (1990). *Qualitative evaluation and research methods* (2nd ed.). Newbury Park, CA: Sage.

247. Perkins, J.A., (1973), *The University as an Organisation*, McGraw-Hill, New York, NY

248. Peter Vaill, (2000), "*Students not Customers*", University of St. Thomas, Minneapolis-St. Paul, MN, http://www.people.vcu.edu/~rsleeth/NotCustomers.html

249. Phillips, D. C., & Burbules, N. C., (2000). Postpositivism and educational research. Lanham, MD: Rowman & Littlefield.

250. Pires da Rosa, M., Saraiva, P., and Diz,, H., (2001), The Development of an Excellence Model for Portuguese Higher Education Institutions. *Total Quality Management*, 12(7,8), 1010-1017.

251. Pires da Rosa, M., Saraiva, P., and Diz, H., (2003), Excellence in Portuguese Higher Education Institutions. *Total Quality Management*, 14(2), 189-197.

252. Pollitt, C. & Bouckaert, G., (1995), *Quality Improvement in European Public Services. Concepts, cases and commentary*. London: Sage.

253. Pounder, J., (1999), Institutional Performance in Higher Education: is quality a relevant concept? *Quality Assurance in Education*, 7(3), 56-163. doi:10.1108/09684889910281719

254. Price, I., Matzdorf, F., Smith, L., and Agahi, H., (2003), The impact of facilities on student choice of university, *Facilities*, Vol. 21 (10), PP. 212-222.

255. Ramsden, P., (1992), *Learning to Teach in Higher Education*. New York, Routledge.

256. Razavi, S. M., Safari, H., & Shafie, H. (2012). Relationships among Service Quality, Customer Satisfaction and Customer Perceived Value: Evidence from Iran's Software Industry. *Journal of Management and Strategy*, *3*(3), 28. http://dx.doi.org/10.5430/jms.v3n3p28

257. Reeves, C.A., & Bednar, D.A., (1994), Defining Quality: alternatives and implications, *Academy of Management Review*, 19, pp. 419-445.

258. Reid, K. and Ashelby, D., (2002), The Swansea Internal Quality Audit Processes: a case study. *Quality Assurance in Education*, 10(4), 237-245.

259. Richards, Alan, (29 Feb. 1992), „Higher Education in Egypt", Policy Research working papers; no. (WPS 862), *Education and Employment*.

260. Richmond, B. (1994). Systems Dynamics/Systems Thinking: Let"s Just Get On With It. *In International Systems Dynamics Conference*. Sterling, Scotland.

261. Richmond, Barry, (2004), *An Introduction to Systems Thinking: with Stella*, ISEE Systems, inc.

262. Rittel, H., & Webber, M. L., (1973), „Dilemmas in a General Theory of Planning", *Policy Sciences 4*, Elsevier Science, pp. 155-169.

263. Roberts, N.H., (ed). (1978), System Simulation of Student Performance in the Elementary Classroom, In Roberts, E.B., (ed). (1978), *Management Applications of System Dynamics*, Productivity Press, Cambridge, MA, USA.

264. Roberts, P. and Tennant, C. (2003) Application of the Hoshin Kanri Methodology at a Higher Education Establishment in the UK. *TQM Magazine*, 15(2), 82-87.

265. Rodrigues LLR, Hebbar S, Suraj S, Leekha D., (September 2012), „Modelling and simulation of quality management in higher education: A system dynamics approach", *In Computational Intelligence, Modelling and Simulation (CIMSiM), 2012), Fourth International Conference*, (pp. 304-309).

266. Roffe, I. (1998) Conceptual Problems of Continuous Quality Improvement and Innovation in Higher Education. *Quality Assurance in Education*, 6(2), 74-82.

267. Rorty, R. (1990). Pragmatism as anti-representationalism. In J. P. Murphy, *Pragmatism: From Peirce to Davison* (pp. 1–6). Boulder, CO: Westview.

268. Rossman, G. B., & Wilson, B. L. (October 1985). Numbers and words: Combining quantitative and qualitative methods in a single large-scale evaluation study. *Evaluation Review, 9*(5), 627–643.

269. Ruben, B. (2004), *Pursuing Excellence in Higher Education*, Jossey Bass, San Francisco, CA.

270. Ryan, P.D. (2010), „The Bologna Process: an introduction", National University of Ireland, Galway

271. Sacks, P., 1996, Generation X Goes to College, Open Court Publishing, Peru, IL.

272. Saeed, K., (1990), Bringing Practicum to Learning: A System Dynamics Modelling Approach*, Higher Education Policy*, Vol. 3, No. 2.

273. Saeed, K., (1993), Bringing experimental learning to the social sciences: a simulation laboratory on economic development*, System Dynamics Review*, Vol. 9, No. 2, pp. 153-164.

274. Saeed, K., (1997), System Dynamics as a Technology for New Liberal Education*, Worcester Polytechnic Institute, Report No. 3,* Worcester, Mass. USA.

275. Sahney, S., Banwet, D.K. and Karunes, S. (2004), "Conceptualizing total quality management on higher education", *The TQM Magazine*, Vol. 16 No. 2, pp. 145-59.

276. Saunders, M.N.K., Lewis, P., and Thornhill, A., (2003), Research Methods For Business Students, 3rd edn, Harlow, Financial Times, Prentice Hall.

277. Schwaninger, M. S., Groesser, N., (2008) , System Dynamics as model-based theory building, System Resource Behaviour Science 25(4):439–445.

278. Schwaninger, M., and Grösser, S. (2009). *System Dynamics Modeling: Validation for Quality Assurance, in Encyclopedia of Complexity and Systems Science,* (R.A. Meyers, ed.), Springer, New York.

279. Seghezzi, H.D. (2001), Business Excellence: what is to be done? *Total Quality Management*, 12, pp. 861-866.

280. Sekaran, U., (2003), Research Methods For Business: A Skill-Building Approach, 4th Ed New York, Wiely.

281. Seng, Ernest Lim Kok, & Ling, Tan Pei, (2013), A Statistical Analysis of Education Service Quality Dimensions on Business School Students" Satisfaction, *International Education Studies*; Vol. 6, No. 8, PP. 136-146.

282. Senge, P.M., Cambron-McCabe, N., Lucas, T., Smith, B.J., Dutton, J. and Kleiner, A. (2000), Schools that Learn, Nicholas Brealey, London.

283. Seymour, D. (1991), TQM on Campus: what the pioneers are finding. *AAHE Bulletin*, 44, pp. 10-18.

284. Shattock, M. (Ed.) (1996), *The Creation of a University System*, Blackwell Publishers, Cambridge, MA.

285. Shattock, M., (July 1997), „The New Managerial Implications of the New Priorities", *Higher Education Management*, Vol. 9, No. 2, pp 27-34.

286. Shattock, M., (March 1999), „The Impact of the Dearing Report on UK Higher Education", *Higher Education Management*, Vol. 11, No. 1, pp 7-17.

287. Shun-Hsing Chen , Hui-Hua Wang, King-Jang Yang (2009). Establishment and application of performance measure indicators for universities, *The TQM Magazine* .Vol. 21 No. 3, pp. 220-235

288. Shutler, P. and Crawford, L. (1998) The Challenge of ISO 9000 Certification in Higher Education. *Quality Assurance in Education*, 6(3), 152-161.

289. Sieber, S. D. (1973). The integration of field work and survey methods. *American Journal of Sociology, 78,* 1335–1359.

290. Skribans, Valerijs, Lektauers, Arnis and Merkuryev, Yuri, (2013), Third Generation University Strategic Planning Model Development, MPRA Paper No. 49168 in *The 31st International Conference of the System Dynamics Society*, Cambridge, Massachusetts, USA. Online at https://mpra.ub.uni-muenchen.de/49168/

291. Smith, J. K., (March 1983). Quantitative versus qualitative research: An attempt to clarify the issue. *Educational Researcher,* 6–13.

292. Sohail, M., Daud, S. and Rajadurai, J., (2006) Restructuring a Higher Education Institution: a case study from a developing country. *International Journal of Educational Management*, 20(4), 279-290.

293. Srikanthan, G. & Dalrymple, J.F., (2002), Developing a Holistic Model Quality in Higher Education. *Quality in Higher Education,* 8, pp. 215-224.

294. Srikanthan, G. & Dalrymple, J.F. , (2007), *A conceptual overview of a holistic model for quality in higher education International Journal of Educational Management* Vol. 21 No. 3, 2007 pp. 173-193.

295. Srikanthan, G. and Dalrymple, J., (2003), "Developing alternative perspectives for quality in higher education", *International Journal of Educational Management*, Vol. 17 No. 3, pp. 126-36.

296. Srikanthan, G. and Dalrymple, J., (2004), A Synthesis of a Quality Management Model for Education in Universities. *International Journal of Educational Management*, 18(4), 266-279.

297. Srikanthan, G., and Dalrymple, J.F., (2007), „A conceptual overview of a holistic model for quality in higher education", *International Journal of Educational Management* 21: PP. 173 – 193.

298. Stake, R. E. (1995). *The art of case study research.* Thousand Oaks, CA: Sage.

299. Stanislav Karapetrovic, Walter Willborn, 1997, "*Creating zero-defect students*", *The TQM Magazine*, Volume 9, Number 4, PP:287-291.

300. Steiger, J. H., and Lind, J. C., (30 May 1980), Statistically-based tests for the number of common factors, Paper presented at the Annual Spring Meeting of the Psychometric Society, Iowa City.

301. Stephenson, J. and Yorke, M., (Eds) (1998), *Capability and Quality in Higher Education*, (2nd ed.), Kogan Page, London.

302. Sterman, J.D., (2000), *Business dynamics: systems thinking and modeling for a complex world*, Boston: Irwin/McGraw-Hill.

303. Strauss, A., & Corbin, J. (1990), *Basics of qualitative research: Grounded theory procedures and technique*, Newbury Park, CA: Sage.

304. Strauss, A., & Corbin, J. (1998). *Basics of qualitative research: Grounded theory procedures and techniques* (2nd ed.). Thousand Oaks, CA: Sage.

305. Strauss, Luıisa Mariele, and Borenstein, Denis (2014). A System Dynamics model for long-term planning of the undergraduate education in Brazil, *Higher Education*, 69 (3): pp. 375–397.

306. Strübing, J. (2004). Grounded Theory, Zur sozialtheoretischen und epistemologischen Fundierung des Verfahrens der empirisch begründeten Theoriebildung, Band 15 der Reihe Qualitative Sozialforschung,nVS Verlag für Sozialwissenschaften, Wiesbaden, Deutschland.

307. Susnea, Elena, (2013). Improving Decision Making Process in Universities: A Conceptual Model of Intelligent Decision Support System, Social and Behavioural Science 76: 795–800, Online at: http://dx.doi.org/10.1016/j.sbspro.2013.04.208 and presented earlier in *the 5th International Conference EDU-WORLD 2012 - Education Facing Contemporary World Issues*.

308. Tam, M. (2002) University Impact on Student Growth: a quality measure? *Journal of Higher Education Policy and Management*, 24(2), 211-218. doi:10.1080/1360080022000013527

309. Tam, M. (2006) Assessing Quality Experience and Learning Outcomes. Part I: Instrument and analysis. *Quality Assurance in Education*, 14(1), 175-87. doi:10.1108/09684880610643629

310. Tanaka, J. S., and G. J. Huba. (1985). A fit index for covariance structure models under arbitrary GLS estimation. *British Journal of Mathematical and Statistical Psychology*, 38: 197–201.

311. Tang, K.H. and Zairi, M. (1998), "Benchmarking quality implementation in a service context; a comparative analysis of financial services and institutions of higher education: Part II", *Total Quality Management*, Vol. 9 No. 7, pp. 539-52.

312. Tari, J. (2006) An EFQM Model Self-Assessment Exercise at a Spanish University. *Journal of Educational Administration*, 44(2), 170-188. doi:10.1108/09578230610652051

313. Tashakkori, A., & Teddlie, C. (Eds.). (2010). *SAGE handbook of mixed methods in social and behavioral research* (2nd ed.). Thousand Oaks, CA: Sage.

314. Taylor, A. and Hill, F., (1993), "Quality management in education", *Quality Assurance in Education,* Vol. 1 No. 1, pp. 21-8.

315. Taylor, A. and Hill, F.M., (1992), "Implementing TQM in higher education", *International Journal of Educational Management*, Vol. 6 No. 4, 1992, pp. 4-10.

316. Temsahi, Ayman, (2001), A Systemic Approach To Performance Measures, Academic PhD Dissertation, Sunderland University.

317. Thakkar, J., Deshmukh, S. and Shastree, A., (2006), „Total Quality Management (TQM) in Self-Financed Technical Institutions", *Quality Assurance in Education*, 14(1), 54-74.

318. Tierney, W.G., (1999), Building the Responsive Campus: Creating High Performance Colleges and Universities, Sage Publications, Thousand Oaks, CA.

319. Tierney, W.G. (Ed.), (1998), The Responsive University: Restructuring for High Performance, The Johns Hopkins University Press, Baltimore, MD.

320. Trow, M. (1994), *Academic Reviews and the Culture of Excellence.* Unpublished seminar paper for the Office of Chancellor of Swedish Universities, Stockholm

321. Try, S., and Grgaard, J.B., (2003), Measuring the Relationship Between Resources and Outcomes in Higher Education in Norway, NIFU skriftserie nr. 27/2003, ISSN 0808 - 4572.

322. Tzvetelin Gueorguiev, (2006), Quality management in higher education, http://qedu.uni-ruse.bg/2006/bg/accpapers/gueorguiev.pdf

323. UNDP (2003), *Egypt Human Development Report 2003*, Cairo, UNDP.

324. Vahdatzad, M. A., & Mojtahedzadeh, M. T., (2000), „Some Issues in the Strategic Management in a fast growing academic Institution: The Case of University of Yadz", *Proceedings of the 18th International Conference of the System Dynamics Society 6-10 August 2000 Bergen-Norway.*

325. Van Patten, J.J. (2000), Higher Education Culture: Case Studies for a New Century, University Press of America, Lanham, MD.

326. Vazzana, G., Elfrink, J. & Bachmann, D.P. (2000), A Longitudinal Study of Total Quality Management Processes in Business Colleges. *Journal of Education for Business*, 76, pp. 69-74.

327. Vennix, JAM, (1996), Group Model Building. Facilitating Team Learning Using System Dynamics. Wiley, Chichester.

328. Veress, G. (1999), *A Felsőoktatási intézmények minőségmenedzsmentje*. Budapest: Műszaki Könyvkiadó.

329. Vickie Schray (2006), *Assuring Quality in Higher Education: Key Issues and Questions for Changing Accreditation in the United States, Issue Paper, The Secretary of Education's Commission on the Future of Higher Education (Fourth in a series of Issue Papers released at the request of Chairman Charles Miller to inform the work of the Commission), U.S. Department of Education, Washington D.C. No date.*

330. Vroeijenstijn, A.I. (1995), *Improvement and Accountability: navigating between Scylla and Charybdis. Guide for external quality assessment in higher education*. London: Jessica Kingsley.

331. Vught, F.A. van (1996), The Humboldtian University under Pressure: new forms of quality review in western higher education. In Maassen, P. & Vught, F.A. van (Eds.), *Inside Academia: new challenges for the academic profession.* Utrecht: De Tijdstroom

332. Wabwire, W.J.K., 2007, Makerere University: Towards 2017 Strategic Choices, Unpublished policy report for Makerere University.

333. Wang, P.C. (1993), "Study on higher education performance indicator", unpublished doctoral dissertation, National University of Cheng-Chi, Cheng-Chi.

334. Watson, D., (January 2000), Managing in Higher Education: The „Wicked Issues", *Higher Education Quarterly*, Vol.54, No.1, pp. 5-21.

335. Watts, R. A. (1987). Measuring software quality. The National Computer Centre, Oxford.

336. Welsh, J. and Dey, S. (2002) Quality Measurement and Quality Assurance in Higher Education. *Quality Assurance in Education*, 10(1), 17-25.

337. West, A., Noden, P., & Gosling, R. (2000). *Quality in higher education: An international perspective. The views of transnational corporations. Market Papers no. 17,* London School of Economics and Political Science.

338. Wheaton, B., B. Muthén, D. F. Alwin, and G. F. Summers. 1977. Assessing reliability and stability in panel models. In: Sociological methodology, D. R. Heise, ed. San Francisco: Jossey-Bass, 84–136.

339. Widrick, S., Mergen, E. and Grant, D. (2002) Measuring the Dimensions of Quality in Higher Education. *Total Quality Management*, 13(1), 123-131. doi:10.1080/09544120120098609

340. Williams, Bob, (Modified on December 2005), Soft Systems Methodology, The Kellogg Foundation, Available on line at: http://www.bobwilliams.co.nz/Systems_Resources_files/ssm.pdf

341. Wolcott, H. T., (2008), *Ethnography: A way of seeing* (2nd ed.), Walnut Creek, CA: AltaMira.

342. Woodhouse, D. (2011a), „Internationalisation of Quality Assurance: The Role Played by the Networks", invited Presentation to 2011 Higher Education Evaluation & Accreditation Council of Taiwan (HEEACT) International Conference, Taiwan, 3 June.
343. Woodhouse, D. (2011b), „Institutional Quality Assurance", Opening presentation to workshop on IQA, CAA, Dubai, 7 May.
344. World Bank (2002), *Arab Republic of Egypt Higher Education Enhancement Project (HEEP)*, p.41, Washington D.C.
345. World Bank (2011), *Higher Education Reform in the Middle East and North Africa*, Washington, DC, The World Bank.
346. Xue, Y., Larson, R.C., (2015), „STEM Crisis or STEM Surplus: Yes and Yes", *Monthly Lab Rev. 2015*; 138:1.
347. Yin, R. K., (2009), *Case study research: Design and methods* (4th ed.). Thousand Oaks, CA: Sage.
348. Yin, R. K., (2012), *Applications of case study research* (3rd ed.). Thousand Oaks, CA: Sage.
349. Yorke, M., (1997), "The elusive quarry: total quality in higher education", *Tertiary Education and Management*, Vol. 3, No. 2, pp. 145-56.
350. Yorke, M., (1999), Assuring Quality and Standards in Globalised Higher Education. *Quality Assurance in Education*, 7(1), 14-24. doi:10.1108/09684889910252496.
351. Zeithaml, V. A., & Bitner, M. J. (2000). *Services Marketing: Integrating Customer Focus Across the Firm*. United States of America: Irwin McGraw-Hill.
352. Zeithaml, V. A., Berry, L. L., & Parasuraman, A. (1996). The behavioral consequences of service quality. *The Journal of Marketing*, 31-46. http://dx.doi.org/10.2307/1251929

APPENDICES

APPENDIX A

Questionnaire Consent Form

Dear Respondent,

You are invited to participate in this survey, which provides an opportunity to reflect on your experience with facilities services at Your University. Please take a few minutes today to respond to this questionnaire. Your participation in this survey is voluntary. Kindly note that your responses will be kept confidential. Survey results will be aggregated as to protect the privacy of the respondent. The results will be analysed and forwarded to the Facilities Department to improve the budget funding allocation to resources. If you have any questions, comments, concerns, or need clarification regarding the content of the survey, do not hesitate to contact the researcher Reem ElHarakany through the email she sent to You the questionnaire from (reem_elharakany@yahoo.com)

Thank you for your participation.

APPENDIX B

Questionnaire

Age Group:

- ☐ 25-34
- ☐ 35-44
- ☐ 45-55
- ☐ over 55

Gender:

- ☐ Female
- ☐ Male

Highest Level of Education Completed:

- ☐ School Graduate
- ☐ College Graduate
- ☐ Post Graduate Degree

Which of the following best describes your role in the university?

- ☐ Upper Management
- ☐ Middle Management
- ☐ Junior Management
- ☐ Consultant
- ☐ Other Please Specify

How long have you been working in the institution?

- ☐ Less than 5 years
- ☐ 5 to 10 years
- ☐ 10 to 20 years
- ☐ Over 20 years

What is your current monthly income?

- ☐ Less than 5000 Egyptian pounds
- ☐ 5000 to 10000 Egyptian pounds
- ☐ 10000 to 20000 Egyptian pounds
- ☐ Over 2000 Egyptian pounds
- ☐ Would rather not to say

The institution you work for is in which of the following:

- ☐ Public Sector
- ☐ Private Sector

Regarding each Facility Criterion, please indicate your level of agreement for each of the following statements to its importance in budget funding allocation:

Serial	Statements	Strongly Agree	Agree	Not Applicable	Disagree	Strongly Disagree
1	Layout of Buildings/Stairs/Offices (welcoming entrance, auditoriums/ meetings areas, enough signage inside and outside, well-marked/has lots of signs, wide stairs, well connected and adjacent), additionally offering Dormitories for					

	Students					
2	Landscaping (Outdoor Space & Seating, Side Walks Paths, Grass/ Tree/ Plant Areas)					
3	Coffee Cart near the library entrance/ Cafeteria/ Dining Areas					
4	Music instruments for personal and social development					
5	Accessibility of portable water, toilets (quality of the toilet rooms, separate toilet for males and females)					
6	Cleanliness (Waste Cans for Trash, Garbage & Recycling)					
7	Attractiveness of the university compound and fencing in terms of buildings‟ condition encompassing university principal‟s office (access to computer, telephone, guest chairs, shelves, shutter), staff rooms (chairs, tables and shelves),					
8	Disability Service/ Accessibility / Handicapped Improvements					
9	Presence of printing service					
10	Accessibility to functional photocopy machines					
11	Efficient overhead projector and LCD Liquid Crystal Display for educational purposes					
12	Classrooms Convenience (floors, walls, and roofs, shutter, student seats, file cabinet, whiteboards, space)					
13	Provision of Health Care services (sanitary materials such as provision of first aid in case of accidents, availability of medication)					
14	Computer devices for staff members, administrators and students					

15	Provision of Buses for Staff & Students Transportation					
16	Parking Lots (well designed & good lighting to ease Traffic Flow and circulation)					
17	Functionality of pedagogical centre					
18	Audio Tape players, CD/DVD players, and TV set for media and educational purposes					
19	Availability of Silent Study Areas					
20	Security (Presence of Security Personnel and Cameras to grant Safety with front desk monitoring & Control loitering)					
21	Availability of Printing & Photocopying Service in the Library					
22	Provision of Comfortable Seating with Low Level Tables, Well-Organized Book Shelves, Proximity of Books & Convenience of Library Environment (Lighting, Temperature, Power Sockets & Wireless Connection for the Access of Online Resources Service)					
23	Stationary materials such as: papers, notebooks, chart and graph papers, pens, pencils and others, besides teaching aids such as white boards, markers, etc.					
24	Sport capital (resources such as playgrounds, changing rooms, bathrooms, etc., purchasing of tools & its maintenance)					
25	Follow Maintenance & Repairing System (Electrical, Energy, Sustainable Practices)					
26	Accessibility to Computer Clusters					

27	Ease of Access to Wide Range of Course Books/ Core Texts and Research Hive (taking into consideration online resources)					
28	Bookstore for providing Text books, Reference books, and Dictionaries, and also Teaching guides and manuals					
29	Laboratory equipment with adequacy of ICT aids‟ application					
30	Recruitment of Qualified Staff for Every Facility					

APPENDIX C

STATISTICAL ANALYSIS SUMMARY

Correlation Coefficients Analysis

S	F	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	X1	1																													
2	X2	0.658**	1																												
3	X3	0.583**	0.640**	1																											
4	X4	0.508**	0.579**	0.720**	1																										
5	X5	0.484**	0.463**	0.603**	0.669**	1																									
6	X6	0.453**	0.452**	0.637**	0.567**	0.620**	1																								
7	X	0	0	0	0	0	0	1																							

	7	.547**	.542**	.688**	.676**	.630**	.713**																								
8	**X8**	0.282**	0.411**	0.566**	0.568**	0.463**	0.590**	0.722**	1																						
9	**X9**	0.258**	0.391**	0.545**	0.540**	0.425**	0.562**	0.708**	0.877**	1																					
10	**X10**	0.455**	0.541**	0.562**	0.623**	0.504**	0.491**	0.647**	0.517**	0.547**	1																				
11	**X11**	0.494**	0.508**	0.620**	0.655**	0.579**	0.546**	0.641**	0.474**	0.477**	0.759**	1																			
12	**X12**	0.482**	0.531**	0.635**	0.663**	0.576**	0.547**	0.734**	0.616**	0.612**	0.672**	0.758**	1																		
13	**X13**	0.566**	0.610**	0.713**	0.718**	0.631**	0.660**	0.763**	0.631**	0.607**	0.672**	0.687**	0.741**	1																	
14	**X14**	0.559**	0.594**	0.656**	0.689**	0.630**	0.653**	0.773**	0.603**	0.600**	0.636**	0.648**	0.777**	0.797**	1																
15	**X15**	0.556**	0.560**	0.688**	0.698**	0.631**	0.626**	0.755**	0.600**	0.593**	0.645**	0.631**	0.746**	0.759**	0.855**	1															
16	**X16**	0.279**	0.390**	0.568**	0.543**	0.419**	0.548**	0.636**	0.732**	0.722**	0.502**	0.461**	0.566**	0.609**	0.601**	0.697**	1														
17	**X17**	0.145*	0.271*	0.241*	0.373*	0.293*	0.286*	0.307*	0.388*	0.396*	0.303*	0.288*	0.325*	0.347*	0.341*	0.334*	0.406*	1													

		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*											
18	**X18**	0.4094***	0.4134***	0.4814***	0.5044***	0.5443***	0.4904***	0.5188***	0.2834***	0.2944***	0.4755***	0.5455***	0.5577***	0.5588***	0.5724***	0.5377***	0.3088***	0.4077***	1											
19	**X19**	0.2424***	0.2044***	0.2711***	0.3033***	0.2404***	0.1525***	0.2330***	0.2377***	0.2088***	0.1233***	0.2615***	0.2699***	0.2111***	0.2111***	0.2333***	0.3199***	0.4488***	0.2915***	1											
20	**X20**	0484***	0.5446***	0.6366***	0.7044***	0.5764***	0.6554***	0.7433***	0.6122***	0.6155***	0.6433***	0.6554***	0.7119***	0.7177***	0.7229***	0.6922***	0.5299***	0.3333***	0.5355***	0.2788***	1										
21	**X21**	0.1777***	0.2688***	0.4266***	0.4844***	0.3330***	0.5366***	0.5555***	0.6199***	0.6388***	0.3788***	0.4477***	0.5633***	0.4944***	0.5055***	0.4799***	0.6111***	0.3955***	0.2411***	0.3044***	0.6099***	1									
22	**X22**	0.4611***	0.5555***	0.6588***	0.6833***	0.6044***	0.6322***	0.7288***	0.5944***	0.6222***	0.5511***	0.6055***	0.7200***	0.7099***	0.7399***	0.7244***	0.5755***	0.4122***	0.5788***	0.2533***	0.7311***	0.5933***	1								
23	**X23**	0.4766***	0.6003***	0.6733***	0.6466***	0.6014***	0.6411***	0.7425***	0.5685***	0.5955***	0.6077***	0.6113***	0.7088***	0.6988***	0.7388***	0.7177***	0.5685***	0.3344***	0.5499***	0.2077***	0.7099***	0.5288***	0.8066***	1							
24	**X24**	0.5905***	0.6655***	0.6399***	0.7155***	0.6107***	0.5977***	0.7088***	0.5325***	0.5235***	0.6511***	0.6636***	0.6666***	0.6899***	0.7335***	0.6988***	0.4966***	0.3077***	0.5377***	0.2977***	0.7477***	0.4677***	0.6905***	0.7344***	1						
25	**X25**	0.5077***	0.5825***	0.6411***	0.6779***	0.5115***	0.6855***	0.6944***	0.5744***	0.5603***	0.6326***	0.6366***	0.6599***	0.6955***	0.6975***	0.6511***	0.5110***	0.2488***	0.4288***	0.1974***	0.7721***	0.5688***	0.6733***	0.6804***	0.8214***	1					
26	**X26**	0.5077***	0.5377***	0.6311***	0.6466***	0.5255***	0.6888***	0.7011***	0.5577***	0.5577***	0.6188***	0.6099***	0.6177***	0.6955***	0.6755***	0.6611***	0.5288***	0.2311***	0.4299***	0.1744***	0.7211***	0.5499***	0.6566***	0.6557***	0.7577***	0.8566***	1				
27	**X27**	0.5899***	0.6225***	0.6799***	0.7188***	0.6005***	0.6655***	0.7166***	0.5655***	0.5555***	0.6887***	0.6911***	0.6933***	0.7311***	0.7377***	0.7005***	0.5566***	0.2633***	0.4825***	0.2085***	0.7566***	0.4955***	0.6833***	0.7044***	0.8144***	0.8012***	0.8125***	1			
28	**X28**	0.61	0.65	0.69	0.73	0.58	0.63	0.74	0.58	0.56	0.68	0.67	0.71	0.74	0.77	0.72	0.57	0.32	0.51	0.27	0.77	0.53	0.71	0.74	0.86	0.83	0.83	0.89	1		

		1**	3**	9**	5**	8**	9**	5**	3**	8**	7**	9**	7**	8**	3**	5**	1**	8**	9**	5**	4**	6**	3**	3**	2**	5**	0**	7**			
29	**X29**	0.552**	0.587**	0.671**	0.747**	0.560**	0.685**	0.724**	0.585**	0.602**	0.688**	0.627**	0.690**	0.723**	0.739**	0.139**	0.609**	0.328**	0.491**	0.164**	0.747**	0.568**	0.719**	0.712**	0.752**	0.769**	0.729**	0.795**	0.844**	1	
30	**X30**	0.558**	0.614**	0.710**	0.693**	0.580**	0.652**	0.791**	0.621**	0.636**	0.693**	0.655**	0.727**	0.744**	0.743**	0.735**	0.586**	0.326**	0.506**	0.228**	0.750**	0.551**	0.725**	0.745**	0.729**	0.750**	0.717**	0.776**	0.810**	0.814**	1
Correlation Analysis																															
** Correlation is significant at the 0.01 level (2-tailed).																															
* Correlation is significant at the 0.05 level (2-tailed).																															

Groups

Group number 1 (Group number 1)

Notes for Group (Group number 1)

The model is recursive.

Sample size = 328

Estimates (Group number 1 - Default model)

Scalar Estimates (Group number 1 - Default model)

Maximum Likelihood Estimates

Regression Weights: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
x1	<---	fa	1.000				
x2	<---	fa	1.201	.111	10.873	***	
x3	<---	fa	1.504	.124	12.115	***	
x4	<---	fa	1.662	.134	12.414	***	
x5	<---	fa	1.195	.109	11.012	***	
x6	<---	fa	1.410	.120	11.730	***	
x7	<---	fa	1.636	.126	12.937	***	
x8	<---	fa	1.222	.110	11.149	***	
x9	<---	fa	1.187	.107	11.092	***	
x10	<---	fa	1.153	.098	11.754	***	
x11	<---	fa	1.146	.097	11.840	***	

	Estimate	S.E.	C.R.	P	Label
x12 <--- fa	1.422	.113	12.535	***	
x13 <--- fa	1.492	.116	12.868	***	
x14 <--- fa	1.582	.122	12.976	***	
x15 <--- fa	1.564	.123	12.751	***	
x16 <--- fa	1.179	.109	10.827	***	
x17 <--- fa	.560	.084	6.663	***	
x18 <--- fa	.974	.099	9.791	***	
x19 <--- fa	.348	.070	4.998	***	
x20 <--- fa	1.619	.126	12.831	***	
x21 <--- fa	1.123	.112	10.044	***	
x22 <--- fa	1.468	.117	12.562	***	
x23 <--- fa	1.492	.118	12.612	***	
x24 <--- fa	1.547	.120	12.906	***	
x25 <--- fa	1.720	.134	12.816	***	
x26 <--- fa	1.796	.143	12.600	***	
x27 <--- fa	1.817	.138	13.130	***	
x28 <--- fa	1.900	.142	13.417	***	
x29 <--- fa	1.714	.131	13.057	***	
x30 <--- fa	1.602	.122	13.093	***	

Standardized Regression Weights: (Group number 1 - Default model)

	Estimate
x1 <--- fa	.622
x2 <--- fa	.684
x3 <--- fa	.789
x4 <--- fa	.815
x5 <--- fa	.695
x6 <--- fa	.755
x7 <--- fa	.864
x8 <--- fa	.706
x9 <--- fa	.702
x10 <--- fa	.757
x11 <--- fa	.765
x12 <--- fa	.827
x13 <--- fa	.858
x14 <--- fa	.868
x15 <--- fa	.847
x16 <--- fa	.680
x17 <--- fa	.388
x18 <--- fa	.601
x19 <--- fa	.285
x20 <--- fa	.854
x21 <--- fa	.620

	Estimate
x22 <--- fa	.829
x23 <--- fa	.834
x24 <--- fa	.861
x25 <--- fa	.853
x26 <--- fa	.833
x27 <--- fa	.883
x28 <--- fa	.911
x29 <--- fa	.876
x30 <--- fa	.879

Variances: (Group number 1 - Default model)

	Estimate	S.E.	C.R.	P	Label
Fa	.422	.068	6.227	***	
e1	.666	.053	12.647	***	
e2	.692	.055	12.593	***	
e3	.580	.047	12.424	***	
e4	.587	.048	12.349	***	
e5	.644	.051	12.580	***	
e6	.632	.051	12.495	***	
e7	.382	.031	12.135	***	
e8	.632	.050	12.567	***	
e9	.612	.049	12.573	***	
e10	.418	.033	12.491	***	
e11	.394	.032	12.477	***	
e12	.395	.032	12.311	***	
e13	.337	.028	12.173	***	
e14	.345	.029	12.112	***	
e15	.407	.033	12.228	***	
e16	.680	.054	12.597	***	
e17	.748	.059	12.748	***	
e18	.708	.056	12.662	***	
e19	.575	.045	12.767	***	
e20	.410	.034	12.191	***	
e21	.853	.067	12.649	***	
e22	.414	.034	12.302	***	
e23	.412	.034	12.284	***	
e24	.351	.029	12.153	***	
e25	.468	.038	12.199	***	
e26	.602	.049	12.289	***	
e27	.393	.033	12.006	***	
e28	.310	.026	11.703	***	
e29	.376	.031	12.060	***	
e30	.317	.026	12.034	***	

Squared Multiple Correlations: (Group number 1 - Default model)

Model Fit Summary

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	46	295.656	107	.000	2.763
Saturated model	153	.000	0		
Independence model	17	5915.394	136	.000	43.496

RMR, GFI

Model	RMR	GFI	AGFI	PGFI
Default model	.052	.904	.862	.632
Saturated model	.000	1.000		
Independence model	.855	.130	.021	.115

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.950	.936	.968	.959	.967
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

Parsimony-Adjusted Measures

Model	PRATIO	PNFI	PCFI
Default model	.787	.747	.761
Saturated model	.000	.000	.000
Independence model	1.000	.000	.000

NCP

Model	NCP	LO 90	HI 90
Default model	188.656	141.242	243.724
Saturated model	.000	.000	.000
Independence model	5779.394	5531.010	6034.104

FMIN

Model	FMIN	F0	LO 90	HI 90
Default model	.904	.577	.432	.745
Saturated model	.000	.000	.000	.000
Independence model	18.090	17.674	16.914	18.453

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.073	.064	.083	.000
Independence model	.360	.353	.368	.000

AIC

Model	AIC	BCC	BIC	CAIC
Default model	387.656	393.015	562.134	608.134
Saturated model	306.000	323.825	886.331	1039.331
Independence model	5949.394	5951.374	6013.875	6030.875

ECVI

Model	ECVI	LO 90	HI 90	MECVI
Default model	1.185	1.040	1.354	1.202
Saturated model	.936	.936	.936	.990
Independence model	18.194	17.434	18.973	18.200

HOELTER

Model	HOELTER .05	HOELTER .01
Default model	147	160
Independence model	10	10

Minimization	.047
Miscellaneous	.375
Bootstrap	.672
Total	1.094

APPENDIX D

Facility Manager Interview

1	Please identify your educational institution in addition to your affiliation with it; ----------
2	How long have you been working in the institution? ----------
3	Illustrate how the university budget is developed and the steps followed in working with the university committee and department chairs on budget development, implementation, and oversight; ---------- ---------- ---------- ----------
4	How the university ensures that budgets are managed effectively and respond to for proposals and what revenue enhancement initiatives have been undertaken. In this context, demonstrate the most affecting facilities and their associated factors that should be assigned the priority while allocating funds for budget plan in the following tables; ---------- ---------- ---------- ---------- Please rank in order of 1 - 5, the contribution of the following on the quality of the

service facilities (1 – least important, 5 very important)

Service Facility Factor	Ranking

How does the spending on the above mentioned facility factor relate to the quality of the service facility? Please fill in the following table:

% increase in spending on service facility factor	None (0-10)	Small (10-30)	Average (30-60)	Good (60-80)	Excellent (80-100)
0					
0.25					
0.5					
0.75					
1.0					

5 Indicate to which extent your budget plan is consistent and integrated with the university academic plan and consequently with the capital campaign goals;

---

6 General comments, and suggestions for improving Budget Plan Allocation for Services.

APPENDIX E

Classrooms Model

Classrooms Data for the Public University

Name Definition

actual_rate_maintenance_to_student rate_of_maintenance/number_of_students

actual_resources_to_student educational_resources/number_of_students

actual_staff_per_student number_of_staff/number_of_students

av_cost_of_maintenance 100000

av_cost_per_item 10000

av_sal 2000*12

educational_resources 30

effect_of_maintenance_on_quality
GRAPH(percent_increase_in_maintenance_to_student,0,2,{0,0,5,19,31,42,60,85,94,96,95//Min:0;Max:100//})

effect_of_resources_on_quality
GRAPH(percent_increase_in_resources_to_students,0,2,{0,0,5,19,31,42,60,85,94,96,95//Min:0;Max:100//})

effect_of_staff_on_quality
GRAPH(percent_increase_in_staff,0,2,{0.7,8.7,18.7,28.7,37.3,46,55.3,63,71,79,93.3//Min:0;Max:100//})

initial_number_maintenance_times 5

initial_number_of_staff 30

initial_number_resources 30

initial_number_resources_to_student initial_number_resources/number_of_students

initial_rate_maintenance_to_student initial_number_maintenance_times/number_of_students

initial_staff_per_student initial_number_of_staff/number_of_students

maintenance maintenance_asset_budget/av_cost_of_maintenance

maintenance_asset_budget wm*total_budget

new_resources resources_budget/av_cost_per_item

new_staff staff_budget/av_sal

number_of_staff 30

number_of_students 4200

percent_increase_in_maintenance_to_student (actual_rate_maintenance_to_student-initial_rate_maintenance_to_student)/initial_rate_maintenance_to_student

percent_increase_in_resources_to_students (actual_resources_to_student-initial_number_resources_to_student)/initial_number_resources_to_student

percent_increase_in_staff (actual_staff_per_student-initial_staff_per_student)/initial_staff_per_student

percent_increase_of_classrooms_on_quality
wm*effect_of_maintenance_on_quality+ws*effect_of_staff_on_quality+wr*effect_of_resources_on_quality

rate_of_maintenance 5

resources_budget total_budget*wr

staff_budget ws*total_budget

staff_leaving 0.08*number_of_staff

total_budget 3465200

wm 0.3

wr 0.2

ws 0.5

Classrooms Data for the Private University

Name Definition

actual_rate_maintenance_to_student rate_of_maintenance/number_of_students

actual_resources_to_student educational_resources/number_of_students

actual_staff_per_student number_of_staff/number_of_students

av_cost_of_maintenance 50000

av_cost_per_item 10000

av_sal 2500*12

educational_resources 20

effect_of_maintenance_on_quality
GRAPH(percent_increase_in_maintenance_to_student,0,1,{0,0,5,19,31,42,60,85,94,96,95//Min:0;Max:100//})

effect_of_resources_on_quality
GRAPH(percent_increase_in_resources_to_students,0,1,{0,0,5,19,31,42,60,85,94,96,95//Min:0;Max:100//})

effect_of_staff_on_quality
GRAPH(percent_increase_in_staff,0,1,{0.7,8.7,18.7,28.7,37.3,46,55.3,63,71,79,93.3//Min:0;Max:100//})

initial_number_maintenance_times 7

initial_number_of_staff 15

initial_number_resources 20

initial_number_resources_to_student initial_number_resources/number_of_students

initial_rate_maintenance_to_student initial_number_maintenance_times/number_of_students

initial_staff_per_student initial_number_of_staff/number_of_students

maintenance maintenance_asset_budget/av_cost_of_maintenance

maintenance_asset_budget wm*total_budget

new_resourcesresources_budget/av_cost_per_item

new_staff staff_budget/av_sal

number_of_staff 15

number_of_students 2300

percent_increase_in_maintenance_to_student (actual_rate_maintenance_to_student-initial_rate_maintenance_to_student)/initial_rate_maintenance_to_student

percent_increase_in_resources_to_students (actual_resources_to_student-initial_number_resources_to_student)/initial_number_resources_to_student

percent_increase_in_staff (actual_staff_per_student-initial_staff_per_student)/initial_staff_per_student

percent_increase_of_maintenance_on_quality
wm*effect_of_maintenance_on_quality+ws*effect_of_staff_on_quality+wr*effect_of_resources_on_quality

rate_of_maintenance 7

resources_budget total_budget*wr

staff_budget ws*total_budget

staff_leaving 0.08*number_of_staff

total_budget 3000000

wm 0.3

wr 0.2

ws 0.5

APPENDIX F

Sports Model

Sports Data for the Public University

Name Definition

actual_pg_per_student number_of_playgrounds/number_of_students

actual_staff_per_student number_of_trainers/number_of_students

actual_tool_per_student number_f_tools/number_of_students

av_cost_of_increase 50000

av_cost_of_tools 5000

av_sal 2000*12

effect_of_pg_on_quality
GRAPH(percent_increase_in_pg_per_student,0,0.1,{0,2.7,7,18,26,37,53,65.3,78,86,100//Min:0;Max:100//})

effect_of_tool_on_quality
GRAPH(percent_increase_in_tool_per_student,0,0.1,{0,2.7,7,18,26,37,53,65.3,78,86,100//Min:0;Max:100//})

effect_of_trainers_on_quality
GRAPH(percent_increase_in_staff,0,0.1,{1,8,11,14.7,23.3,40,57.3,67.3,80,97.3,100//Min:0;Max:100//})

initial_number_of_staff 15

initial_number_pg 7

initial_number_tools 50

initial_pg_per_studentinitial_number_pg/number_of_students

initial_staff_per_student initial_number_of_staff/number_of_students

initial_tools_per_student initial_number_tools/number_of_students

new_areas playgrounds_budget/av_cost_of_increase

new_tools tools_budget/av_cost_of_tools

new_trainers trainers_budget/av_sal

number_f_tools 50

number_of_playgrounds 7

number_of_students 4200

number_of_trainers 15

percent_increase_in_pg_per_student (actual_pg_per_student-initial_pg_per_student)/initial_pg_per_student

percent_increase_in_staff (actual_staff_per_student-initial_staff_per_student)/initial_staff_per_student

percent_increase_in_tool_per_student (actual_tool_per_student-initial_tools_per_student)/initial_tools_per_student

percent_increase_of_sports_on_quality
wt*effect_of_tool_on_quality+ws*effect_of_trainers_on_quality+wp*effect_of_pg_on_quality

playgrounds_budget wp*total_budget

tools_budget wt*total_budget

total_budget 140000

trainers_budget ws*total_budget

trainers_leaving 0.02*number_of_trainers

wp 0.3

ws 0.4

wt 0.3

Sports Data for the Private University

Name Definition

actual_pg_per_student number_of_playgrounds/number_of_students

actual_staff_per_student number_of_trainers/number_of_students

actual_tool_per_student number_f_tools/number_of_students

av_cost_of_increase 90000

av_cost_of_tools 7000

av_sal 4000*12

effect_of_pg_on_quality
GRAPH(percent_increase_in_pg_per_student,0,0.1,{0,2.7,7,18,26,37,53,65.3,78,86,100//Min:0;Max:100//})

effect_of_tool_on_quality
GRAPH(percent_increase_in_tool_per_student,0,0.1,{0,2.7,7,18,26,37,53,65.3,78,86,100//Min:0;Max:100//})

effect_of_trainers_on_quality
GRAPH(percent_increase_in_staff,0,0.1,{1,8,11,14.7,23.3,40,57.3,67.3,80,97.3,100//Min:0;Max:100//})

initial_number_of_staff 15

initial_number_pg 10

initial_number_tools 250

initial_pg_per_studentinitial_number_pg/number_of_students

initial_staff_per_student initial_number_of_staff/number_of_students

initial_tools_per_student initial_number_tools/number_of_students

new_areas playgrounds_budget/av_cost_of_increase

new_tools tools_budget/av_cost_of_tools

new_trainers trainers_budget/av_sal

number_f_tools 250

number_of_playgrounds 10

number_of_students 2300

number_of_trainers 15

percent_increase_in_pg_per_student (actual_pg_per_student-initial_pg_per_student)/initial_pg_per_student

percent_increase_in_staff (actual_staff_per_student-initial_staff_per_student)/initial_staff_per_student

percent_increase_in_tool_per_student (actual_tool_per_student-initial_tools_per_student)/initial_tools_per_student

percent_increase_of_sports_on_quality wt*effect_of_tool_on_quality+ws*effect_of_trainers_on_quality+wp*effect_of_pg_on_quality

playgrounds_budget wp*total_budget

tools_budget wt*total_budget

total_budget 630000

trainers_budget ws*total_budget

trainers_leaving 0.02*number_of_trainers

wp 0.3

ws 0.2

wt 0.5

APPENDIX G

Health Care Model

Health Care Data for the Public University

Name Definition

actual_eq_per_studentnumber_medical_equipment/number_of_students

actual_med_per_student number_f_meds/number_of_students

actual_staff_per_student number_of_staff/number_of_students

av_cost 5000

av_sal 3000*12

average_cost_of_meds 300

c_staff_budgetstaff_budget*0.4

dep 0.02*number_medical_equipment

effect_of_eq_on_quality
GRAPH(percent_increase_in_eq_per_student,0,0.1,{0,4,14,28.7,39,46,51,59.3,71,83.3,100//Min:0;Max:100//})

effect_of_med_on_quality
GRAPH(percent_increase_in_meds_per_student,0,0.1,{0.7,6,14,28.7,39,46,51,59.3,71,83.3,91.3//Min:0;Max:100//})

effect_of_staff_on_quality
GRAPH(percent_increase_in_staff_sal,0,0.1,{0,10.7,16.7,28.7,37,49,57.3,65.3,74,85.3,100//Min:0;Max:100//})

eq_budget we*total_budget

expirednumber_f_meds*0.05

inc (new_eq_budget+maintenance_budget)/av_cost

initial_eq 1000

initial_eq_per_studentinitial_eq/number_of_students

initial_meds_per_student initial_number_meds/number_of_students

initial_number_meds 500

initial_number_of_staff 100

initial_staff_per_student initial_number_of_staff/number_of_students

maintenance_budget eq_budget/2

meds_budget wt*total_budget

new_eq_budget eq_budget/2

new_meds meds_budget/average_cost_of_meds

number_f_meds 500

number_medical_equipment 1000

number_of_staff 100

number_of_students 4200

p_staff_budgetstaff_budget*0.6

percent_increase_in_eq_per_student (actual_eq_per_student-initial_eq_per_student)/initial_eq_per_student

percent_increase_in_meds_per_student (actual_med_per_student-initial_meds_per_student)/initial_meds_per_student

percent_increase_in_staff_sal(actual_staff_per_student-initial_staff_per_student)/initial_staff_per_student

percent_increase_of_HealthCare_on_quality
wt*effect_of_med_on_quality+ws*effect_of_staff_on_quality+we*effect_of_eq_on_quality

prescribed number_f_meds*0.9

staff (p_staff_budget+c_staff_budget)/av_sal

staff_budget ws*total_budget

staff_leaving 0.02*number_of_staff

total_budget 464000

we 0.2

ws 0.4

wt 0.4

Health Care Data for the Private University

Name Definition

actual_eq_per_studentnumber_medical_equipment/number_of_students

actual_med_per_student number_f_meds/number_of_students

actual_staff_per_student number_of_staff/number_of_students

av_cost 5000

av_sal 4000*12

average_cost_of_meds 300

c_staff_budgetstaff_budget*0.4

dep 0.02*number_medical_equipment

effect_of_eq_on_quality
GRAPH(percent_increase_in_eq_per_student,0,0.1,{0,4,14,28.7,39,46,51,59.3,71,83.3,100//Min:0;Max:100//})

effect_of_med_on_quality
GRAPH(percent_increase_in_meds_per_student,0,0.1,{0.7,6,14,28.7,39,46,51,59.3,71,83.3,91.3//Min:0;Max:100//})

effect_of_staff_on_quality
GRAPH(percent_increase_in_staff_sal,0,0.1,{0,10.7,16.7,28.7,37,49,57.3,65.3,74,85.3,100//Min:0;Max:100//})

eq_budget we*total_budget

expirednumber_f_meds*0.05

inc (new_eq_budget+maintenance_budget)/av_cost

initial_eq 700

initial_eq_per_studentinitial_eq/number_of_students

initial_meds_per_student initial_number_meds/number_of_students

initial_number_meds 400

initial_number_of_staff 50

initial_staff_per_student initial_number_of_staff/number_of_students

maintenance_budget eq_budget/2

meds_budget wt*total_budget

new_eq_budget eq_budget/2

new_meds meds_budget/average_cost_of_meds

number_f_meds 400

number_medical_equipment 700

number_of_staff 50

number_of_students 2300

p_staff_budgetstaff_budget*0.6

percent_increase_in_eq_per_student (actual_eq_per_student-initial_eq_per_student)/initial_eq_per_student

percent_increase_in_meds_per_student (actual_med_per_student-initial_meds_per_student)/initial_meds_per_student

percent_increase_in_staff_sal(actual_staff_per_student-initial_staff_per_student)/initial_staff_per_student

percent_increase_of_HealthCare_on_quality
wt*effect_of_med_on_quality+ws*effect_of_staff_on_quality+we*effect_of_eq_on_quality

prescribed number_f_meds*0.85

staff (p_staff_budget+c_staff_budget)/av_sal

staff_budget ws*total_budget

staff_leaving 0.02*number_of_staff

total_budget 500000

we 0.2

ws 0.4

wt 0.4

APPENDIX H

Extra Facilities Model

Extra Facilities Data for the Public University

Name Definition

abv_cost_of_Premises_maintenance 500

actual_rate_of_safety_maintenance_student
rate_of_safety_maintenance/number_of_students

actual_rate_premises_maintenance_to_student
rate_of_premises_maintenance/number_of_students

actual_staff_per_student number_of_staff/number_of_students

av_cost_of_safety_maintenance 60

av_sal 3000*12

effect_of_premises_maintenance_on_quality
GRAPH(percent_increase_in_premises_maintenance_rate_to_student,0,0.1,{0,0,5,19,31,42,60,85,94,96,95//Min:0;Max:100//})

effect_of_safety_maintenance_on_quality GRAPH('percent_increase_safety maintenance_to_student',0,0.1,{0,0.7,7,19.3,27.3,33,39,47.3,65,83.3,99.3//Min:0;Max:100//})

effect_of_staff_on_quality
GRAPH(percent_increase_in_staff_sal,0,0.1,{0,10.7,16.7,28.7,37,49,57.3,65.3,74,85.3,100//Min:0;Max:100//})

initial_number_of_staff 100

initial_rate_premises_maintenance 5

initial_rate_premises_maintenance_to_student
initial_rate_premises_maintenance/number_of_students

initial_safety_maintenance_rate 200

initial_safety_maintenance_rate_to_student
initial_safety_maintenance_rate/number_of_students

initial_staff_per_student initial_number_of_staff/number_of_students

number_of_staff 100

number_of_students 4200

percent_increase_in_premises_maintenance_rate_to_student
(actual_rate_premises_maintenance_to_student-
initial_rate_premises_maintenance_to_student)/initial_rate_premises_maintenance_to_studen
t

percent_increase_in_staff_sal (actual_staff_per_student-
initial_staff_per_student)/initial_staff_per_student

percent_increase_of_extra_facilities_on_quality
wl*effect_of_safety_maintenance_on_quality+wp*effect_of_premises_maintenance_
on_quality+ws*effect_of_staff_on_quality

percent_increase_safety maintenance_to_student
(actual_rate_of_safety_maintenance_student-
initial_safety_maintenance_rate_to_student)/initial_safety_maintenance_rate_to_student

permises_budget wp*total_budget

premises_maintenance_times permises_budget/abv_cost_of_Premises_maintenance

rate_of_premises_maintenance 5

rate_of_safety_maintenance 200

safety_budget wl*total_budget

Safety_maintenance_times safety_budget/av_cost_of_safety_maintenance

staff (staff_budget)/av_sal

staff_budget ws*total_budget

staff_leaving 0.02*number_of_staff

total_budget 2000000

wl 0.75

wp 0.05

ws 0.2

Extra Facilities Data for the Private University

Name Definition

actual_rate_of_safety_maintenance_student
rate_of_safety_maintenance/number_of_students

actual_rate_premises_maintenance_to_student
rate_of_premises_maintenance/number_of_students

actual_staff_per_student number_of_staff/number_of_students

av_cost_of_Premises_maintenance 50000

av_cost_of_safety_maintenance 10000

av_sal 4000*12

effect_of_premises_maintenance_on_quality
GRAPH(percent_increase_in_premises_maintenance_rate_to_student,0,0.1,{0,0,5,19,31,42,60,85,94,96,95//Min:0;Max:100//})

effect_of_safety_maintenance_on_quality GRAPH('percent_increase_safety maintenance_to_student',0,0.1,{0,0.7,7,19.3,27.3,33,39,47.3,65,83.3,99.3//Min:0;Max:100//})

effect_of_staff_on_quality
GRAPH(percent_increase_in_staff_sal,0,0.1,{0,10.7,16.7,28.7,37,49,57.3,65.3,74,85.3,100//Min:0;Max:100//})

initial_number_of_staff 100

initial_rate_premises_maintenance 100

initial_rate_premises_maintenance_to_student
initial_rate_premises_maintenance/number_of_students

initial_safety_maintenance_rate 300

initial_safety_maintenance_rate_to_student
initial_safety_maintenance_rate/number_of_students

initial_staff_per_student initial_number_of_staff/number_of_students

number_of_staff 100

number_of_students 2300

percent_increase_in_premises_maintenance_rate_to_student
(actual_rate_premises_maintenance_to_student-initial_rate_premises_maintenance_to_student)/initial_rate_premises_maintenance_to_student

percent_increase_in_staff_sal(actual_staff_per_student-initial_staff_per_student)/initial_staff_per_student

percent_increase_of_extra_facilities_on_quality
wl*effect_of_safety_maintenance_on_quality+wp*effect_of_premises_maintenance_on_quality+ws*effect_of_staff_on_quality

percent_increase_safety maintenance_to_student
(actual_rate_of_safety_maintenance_student-initial_safety_maintenance_rate_to_student)/initial_safety_maintenance_rate_to_student

permises_budget wp*total_budget

premises_maintenance_times permises_budget/av_cost_of_Premises_maintenance

rate_of_premises_maintenance 100

rate_of_safety_maintenance 30

safety_budget wl*total_budget

Safety_maintenance_times safety_budget/av_cost_of_safety_maintenance

staff (staff_budget)/av_sal

staff_budget ws*total_budget

staff_leaving 0.02*number_of_staff

total_budget 3500000

wl 0.5

wp 0.2

ws 0.3