A dynamic modelling of the key quality management factors affecting students' satisfaction in the Egyptian public higher education

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Abstract

The study aims at developing a system dynamics model for investigating the critical success factors of total quality management affecting students 'satisfaction within the new Engineering programs in the Egyptian public higher education. Different simulation scenarios were made to determine the success factors which improve the students 'satisfaction within the new Engineering programs.

The research sampling was designed based on the cluster sampling. Accordingly, the faculties of Engineering in Alexandria University and Helwan University were selected by the technique of cluster random sampling. So, ten New Academic Programs of the engineering sector in both Alexandria University and Helwan University were randomly selected to measure the impact of critical success factors of Total Quality Management on students 'satisfaction.

The dynamic hypothesis and simulation model were formulated based on the literature and Group Model Building as primary data. Further, the sources of secondary data collection included internal sources from the records and database in the new Engineering programs and external sources from the records and databases in several governmental bodies in Egypt such as the management of public universities, the projects management unit, and the Ministry of Higher Education.

The validation of the dynamic model was confirmed by using the real data in the last two years. The tests series of the system dynamics model were made by using the latest release of Powersim Studio 10 software. The results of the study identified several success factors of quality management significantly affecting students' satisfaction within the engineering public higher education through using one of the system dynamics tests, such as a what-if scenarios test, on the model. These factors included the percentage of Ph.D. holders, facilities cost per student, quality of teaching, and quality of student learning. General recommendations were made to the Egyptian Ministry of Higher Education concerning the improvement of students 'satisfaction.

1. Introduction

The literature states that quality management in Higher Education Institutions (HEIs) is a challenging task. The first reason is that quality has dissimilar meanings for different stakeholders (Becket & Brookes, 2008). In the higher education context, different or contradictory definitions of quality can be stated by internal and external stakeholders. Pounder (1999) claimed that quality is a notoriously ambiguous concept because it has dissimilar meanings for different stakeholders. Consequently, the measurement and management of quality has demonstrated that it is a contentious topic because of the difficulty in defining quality.

One of the troubles in perceiving the concept of quality in HEIs is associated with customer satisfaction (Arjomandi, et al., 2009).They claim that customers are all people directly or indirectly purchasing products or services. Customers or stakeholders in the environment of HEIs represent students, actual and potential employers, funding organizations, governmental bodies, and research fellows. Madu and Kuei (1993) mentioned that the student may be the primary stakeholder on the one hand, but that there are other stakeholders such as parents, potential employers and the whole society on the other hand. What's more, there is no easy accessibility for these several groups of customers.

In addition to this, quality management is focused not only on quality of service or product, but also includes the means of achieving it. Consequently, quality management uses quality assurance processes to accomplish consistent quality. The procedures of quality assurance are usually concerned with the external stakeholders (Becket & Brookes, 2008). Quality assurance means "planned and systematic actions necessary to provide adequate confidence that a product or service will satisfy given requirements for quality" (Borahan & Ziarati, 2002: 914).

Internationally, higher education has expanded over the recent decades, and governmental agendas as external stakeholders are playing a vital role in measuring the procedures and appropriate levels of quality (Jackson, 1996). Consequently, HEIs must prove the actions of their professional practices and the accountability for results and resources (Jackson, 1998). For this reason, The National Authority for Quality Assurance and Accreditation of Education (NAQAAE) was established to accredit the quality of educational institutions in Egypt (NAQAAE, 2009).

Becket and Brookes (2008) have indicated that the evaluation mechanism of higher education implemented by internal stakeholders can be made by self-evaluation practices and students' feedback, since, as indicated in the Wiklund et al. (2003) study, the student is an essential part of the process of learning. Thus, this evaluation has a formative nature and the improvement of quality in HEIs is a continuous ongoing process. Furthermore, the evaluations of internal stakeholders for HEIs are very important factors in reinforcing the culture of quality management.

The complex nature of the educational product is the second main reason for the difficultly involved in managing the quality of higher education (Becket & Brookes, 2008). For this reason, this research used the system dynamics approach to overcome the complexity of the higher education system. Education has been observed as a system or a network of interdependent parts which work together to achieve the aim of the system. Apart from that, as indicated in the Arjomandi, et al. (2009) study, the quality of higher education is understood in light of the Input-Process-Output (IPO) framework.

Sahney et al. (2004) stated that the inputs of education are represented in the human, physical, and financial resources. These inputs support the education processes. As a result, teaching and learning processes become a central part in perceiving the system of higher education. Moreover, the high quality of teaching may contribute to the high quality of the learning process. Outputs are the final result for any system and, in general, the outputs or the final end result of an education system may be intangible, tangible or added value such as the final results of exams, employment rate, earnings and student satisfaction (Tari, 2006). Besides, the system of education must recognize the important role of the student within all three system parties (Becket & Brookes, 2008).

2. Literature Review

2.1. Total Quality Management and System Thinking in Higher Education

The results of the literature review have indicated that there is a conflict concerning Total Quality Management (TQM) usefulness in HEIs (Meirovich & Romar, 2006). Many authors believe that TQM values are equally applicable in HEIs (Sirvanci, 2004) and compatible with HEIs (Venkatraman, 2007). Moreover, Bayraktar et al. (2008) have found that a number of TQM elements could play a vital role in improving the processes within the higher education context. These

elements include leadership, vision, measurement and evaluation, process control and improvement, quality system improvement, employee involvement, evaluation and training, student focus and other stakeholder focuses.

TQM could play a significant role in improving the processes of higher education and development of customer satisfaction. In other words, if the elements of TQM are more important in one context, the same elements may be less important in another context such as in the different sectors of the economy (Asif et al., 2013).

On the other hand, different authors have argued that TQM values are just marginally beneficial in dynamic and changed environments, such as the modern higher education system (Houston, 2007). Asif et al. (2013) have indicated that the tools and techniques of TQM cannot meet the nature of learning and teaching process in HEIs. Otherwise, the focus of systems thinking can be shifted from being controlling means to broader considerations in the HEIs system, such as achieving the preferred ends of higher education.

Besides, several authors noted significant difficulties in implementing the TQM in HEIs (Asif et al., 2013). The meaning of quality and academic freedom, distinctive nature of academic processes and customer definition are considered the most important difficulties in implementing the TQM in HEIs (Asif et al., 2013; Owlia & Aspinwall, 1997). Other studies reported that there are problems in defining the customers in the HEIs (Quinn, et al., 2009; Sirvanci, 2004).

However, in some different studies on quality in higher education (Chen, 2006; Houston, 2007; Raouf, 2004) students were defined as customers. In other cases, the industry was described as customer and graduates, who were considered as product of HEIs. Therefore, students in HEIs may be considered as work-in-process (Asif, et al., 2013).

The system thinking approach can be used to overcome the problems of customer definition in the higher education context. It also considers the requirements of key stakeholders; namely, graduates, employers, funders and regulatory bodies. On the other side, the system thinking approach may take into consideration the demand of customers and other stakeholders during the execution of key business processes (Asif, et al., 2013). As a result, the definition of quality in HEIs according to the system thinking approach is "the ability of student's knowledge to satisfy stated requirements" (Karapetrovic & Willborn, 1997: 287). These requirements were posited by the accreditation bodies, professional societies and employers. Even though the concepts, elements and language of TQM are very attractive, they could not match the essence of higher education. So, it is necessary to apply the systems thinking approach in the HEIs (Houston, 2007)

Also, Khanna et al., (2003) claimed that the system dynamics is one of the significant tools of system thinking which has the ability to capture the interactions among a wide range of system variables. It can also predict the trends of variables over a period of time. In addition, Mohamed and Chinda (2011) indicated that the system dynamics modelling approach was differentiated with key features from the TQM models such as EFQM model. The key features are the ability of system dynamics modelling to deal effectively with dynamic changes over time, getting feedback processes, using the soft data and testing the different alternative scenarios without implementing them in actuality. Furst-Bowe (2011) stated that the final value of systems thinking in higher education is that it provides HEIs with the ability to achieve the institutional goals and sustain consistent performance developments over time. Therefore, the system dynamics methodology has been used in the current research to improve the quality in Egyptian higher education universities.

2.2. Importance of System Thinking

System thinking is a powerful method to understand the real system that confirms the relationships among the parts of a system instead of the parts themselves (Sterman, 2000). Schiuma et al., (2012) mentioned that system thinking includes dissimilar methodologies and tools that are mainly used to analyze the relationships characterizing a system. Most of them are relevant, particularly in management, as in system dynamics (Morecroft and Sterman, 1994) and business

dynamics (Sterman, 2000). Apart from that, they support the use of nonlinear dynamic models that are differentiated by elements associated with cyclical instead of chains of linear cause and effect relationships. System thinking is a conceptual framework for problem-solving that considers problems in their entirety. Outcomes of system thinking depend strongly on the way of system definition because system thinking examines the different relationships among the numerous parts of the system (Mehrjerdi, 2013).According to Gould-Kreutzer (1993), the terms 'systems thinking' and 'system dynamics' are frequently used in the literature. They were synonymously used in some cases, but in other cases, a distinction between them was suggested. What is more, system dynamics is considered a subsection of a larger systems thinking framework.

2.3. Success Factors of Quality Management and Student Satisfaction

TQM is considered an important approach for developing the process performance and customer satisfaction in different environments. It was not fully developed to improve the processes but its factors were developed over time. The improvements were mainly created using hands on experience, and the implementation of TQM was not completely related to the theory. Therefore, the different components of TQM were not associated with each other in a one comprehensive view. Thus, there was a high degree of motivation in different environments to identify the CSFs of TQM because these CSFs played a vital role for the success of TQM in HEIs (Asif et al., 2013). Furthermore, few studies were interested in identifying the CSFs of TQM.

Joseph et al. (1998) established ten CSFs of TQM. They were quality policy, organizational commitment, product design, quality information system, operating procedures, human resources management, supplier integration, training, role of the quality department, and technology utilization. Additionally, other studies developed CSFs in the higher education context. For example, Azma (2010) supported the concept that the key success factors of HEIs were facilities, research, processes, education and technology, social and cultural activities, faculty members, students, and financial affairs. Facilities were also one of the best factors influencing the students 'satisfaction. Asif et al. (2013) developed six CSFs in Pakistani universities, which included leadership, vision, program design and resource allocation, measurement and evaluation, process control and improvement, and other stakeholders.

The Egyptian university student population reached one million in 2011 (World Bank Group, 2016), with a forecasted annual increase of 350, 000 students (SCU, 2016), which represents a great strain on the EPUs(Schomaker, 2015).The Egyptian government has taken positive steps to reform the public sector of HEIs. As results of a national conference in 2000, the Egyptian government perceived the need to establish a national quality assurance system in the public higher education. The quality assurance mechanism was considered by the government as a gateway to improve the educational process, confidence level in the Egyptian Public Universities (EPUs),students 'and graduates 'satisfaction. The government made a long term plan for reforming the higher education system. This plan established twenty-five specific reform projects using World Bank funding in addition to local fund contributions (Elassy, 2015).

On the other side, PMU within the Egyptian Ministry of HE underlined that the Monitoring and Evaluation of New Programs Project (MENPP) that established the New Academic Programs (NAPs) is one of the most important projects to reform the quality of public higher education and improve students 'satisfaction. Therefore, MENPP as a governmental entity established the NAPs to apply the quality assurance standards effectively within the EPU(MHE, 2010; Elassy, 2015).

Moreover, improvements in higher education quality can be ensured by measuring students' satisfaction and differentiated graduates' skills, an example of which is the ability to solve problems. Accordingly, substantial resources to finance the technological development will be required. Additionally, curricula updating; improving teaching techniques, learning methods, and skills of the academic staff; and salary increases require substantial resources as well. This can be a great reason to increase the desire for improving the competitiveness of the Egyptian economy, and displays the

need to sustain a great level of economic growth. This, in turn, requires the effective implementation of quality assurance in the EPUs (Elassy, 2015). Accordingly, there was a high commitment from the Egyptian Ministry of Higher Education for the continuous improvements of NAPs in different scientific disciplines within the EPUs (MHE, 2010).

Because of what the NAPs can contribute in enhancing the comprehensive strategic plan of higher education reforms, MENPP implemented eleven standards to evaluate the quality assurance of NAPs in the EPU. These standards included mission, program organization, financial and supportive physical resources, academic standards, program design, students, academic staff, teaching and learning, assessment methods of students, plans for development and enhancement, and success indicators for NAPs. Besides that, the PMU established weights for these standards according to the relative importance of each. These relative weights were based on the rating of higher education quality experts in the PMU and Egyptian HEIs. The highest weights were for the financial and supportive physical resources, program design, students, teaching and learning, and assessment methods of students (HEEP, 2017). The researchers also depended on the viewpoint of quality management experts and reviewers in the Egyptian HEIs as a Group Model Building (GMB) to identify the CSFs of TQM.GMB also supported the above standards, which had the highest weights representing the CSF of quality management in the Egyptian HEIs. Based on the viewpoint of GMB, CSFs of TQM, and quality assurance standards of PMU in the literature, the researchers focused on the financial and supportive physical resources, program design, students' satisfaction, teaching and learning, and assessment methods of students as CSFs in the Egyptian public universities. NAPs applied Western quality assurance methods and were identified by self-learning culture, small numbers of high fee-paying students to finance the infrastructure, and matching curricula with the labour market (MHE, 2010).

It is important for the Egyptian government to evaluate the success of this initiative, and this is the driving force of this research. There is no research in the literature associated with measuring the effect of CSFs for quality management on either students' satisfaction or quality of education in the HEIs, both of which remain little studied in literature (Asif et al, 2013) and especially in the NAPs within the EPUs. As a result, the current research will contribute by filling this gap of knowledge. A critical analysis of the success and efficiency of this initiative will be a major contribution to the decision making of the Egyptian Ministry of Education.

3. Methodology

In 2008, the Egyptian government established Fifty-four NAPs in the EPUs to improve the quality of public higher education and stakeholders 'satisfaction. The oldest sector established in the NAPs was the Engineering sector, and it got the highest share of reform in the EPUs, because it has about fifty percent of NAPs compared to the other sectors (MHE, 2010; HEEP, 2017).Therefore, the research population was represented by the engineering sector of the Egyptian higher education. The research sample was based on the cluster random sampling (Malhotra, 2010). As a result, the faculties of engineering in EPUs that applied the NAPs were divided into clusters. The random sampling of clusters was selected based on probability sampling techniques. Therefore, the Faculties of Engineering in Alexandria University and Helwan University were selected by cluster random sampling.

The number of NAPs of the engineering sector in both Alexandria University and Helwan University were ten NAPs. They were randomly selected to evaluate the impact of CSFs of TQM on students 'satisfaction. Moreover, the research depended on the view of GMB as primary data to formulate the research problem and build the CLD of the research. The secondary data for two years was also used to conduct the required tests for the dynamic hypothesis by using the system dynamics methodology. The sources of secondary data were divided into internal and external. The internal sources were the reports, records and database within the management of Egyptian universities and engineering faculties. In addition, external sources such as annual reports, records

and databases of the Egyptian Ministry of Higher Education and the PMU as government sources were used because the quality assurance standards of NAPs are annually monitored and reviewed by these entities. Data collection was based on the census method of the selected random cluster sample. This allows the results to be generalized as the sample is representative of a target population. The test series of the system dynamics model were made by using Powersim Studio 10 software.

According to the system dynamics methodology, a disciplined process of modeling consists of the following activities and it should be followed by all successful modelers; namely, (1) problem articulation, (2) formulating a dynamic hypothesis, (3) formulating a simulation model, (4) testing and, (5) policy design and evaluation (Sterman, 2000). Therefore, the research problem was represented in the following question.

3.1. Research Problem

The problem of the research is stated in the following question: "What are the CSFs of quality management that dynamically affect students' satisfaction in the NAPs within the EPUs?"

3.2. Causal Loop Diagram

The CLD is the dynamic hypothesis of this research. The dynamic hypothesis should be developed to identify the problematic behavior as a second step of the modeling process after identifying and articulating the problem. The hypothesis is dynamic because it offers the nonlinear dynamic behavior of the complex research problem throughout the feedbacks and interlinked loops networks of the system. It then identifies the main reasons of the system's problem. Based on the view of GMB, the key indicators of successful quality management factors were identified in Figure 1, for example, student training, percentage of self-regulated courses, percentage of Ph.D. holders and, students' satisfaction. The series of dynamic relationships among the above variables were also defined in the CLD. According to the literature, as shown in Figure 1, CLD was built based on the CSFs of TQM, key success standards of NAPs within the Egyptian Ministry of Higher Education in the literature, and the view of the GMB.

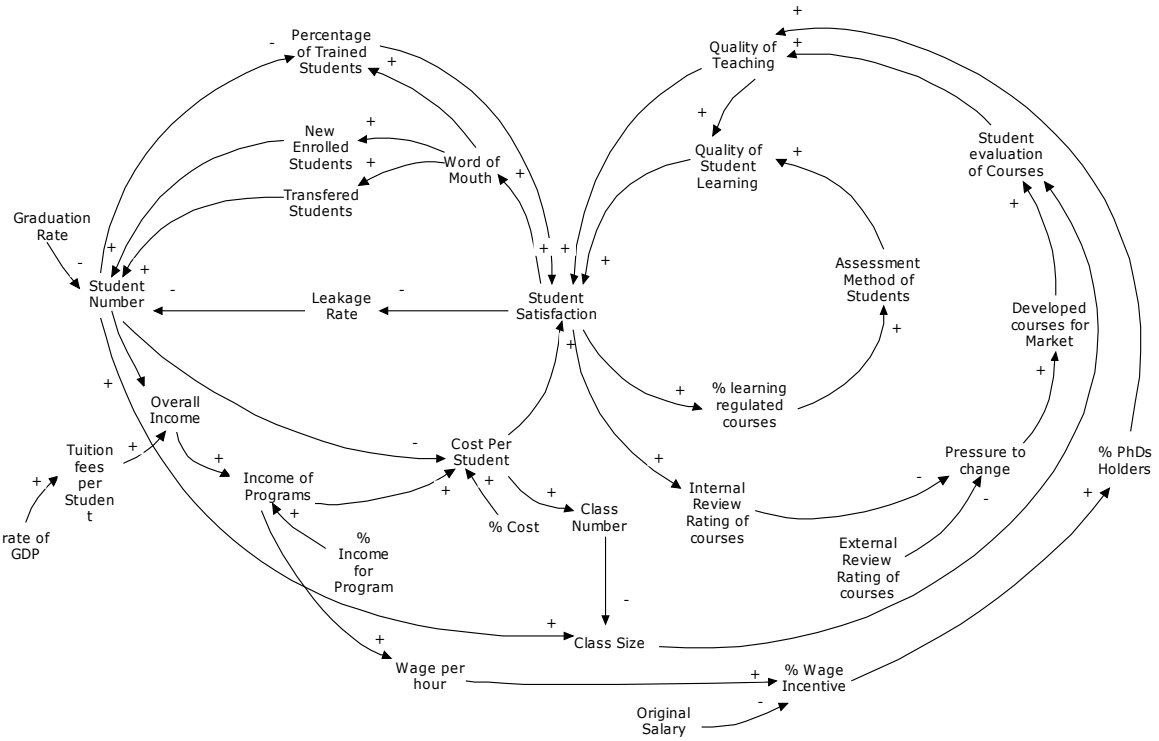

Figure 1. Dynamic Hypothesis of Causal Loop Diagram

The CLD is a useful map in showing the causal links among the variables by using the arrows from a cause to an effect. It also confirms the feedback structure of the system, but the stock and flow diagram confirms its underlying physical structure (Sterman, 2000; Wang et al., 2013). CLD as a qualitative tool and a stock and flow diagram as a quantitative tool, were used in the current research to develop maps of causal structure.

3.3. Stock and Flow Diagram

The researchers formulated the specified formal model, equations, parameters and weights values of the model, and initial conditions based on the secondary data and the view of the GMB instead of the conceptual model as a third step for system dynamics methodology (Sterman, 2000, Wang et al., 2013). The researchers followed the Step-By-Step approach in the development process of Stock and Flow Diagram (SFD) (Pejic-Bach and Ceric, 2007).Stocks are accumulations (Sterman, 2000). As can be shown in Figure 2, students' number, students' satisfaction, quality of teaching, and quality of learning are treated as stocks. The remaining factors are treated as constants and auxiliaries.

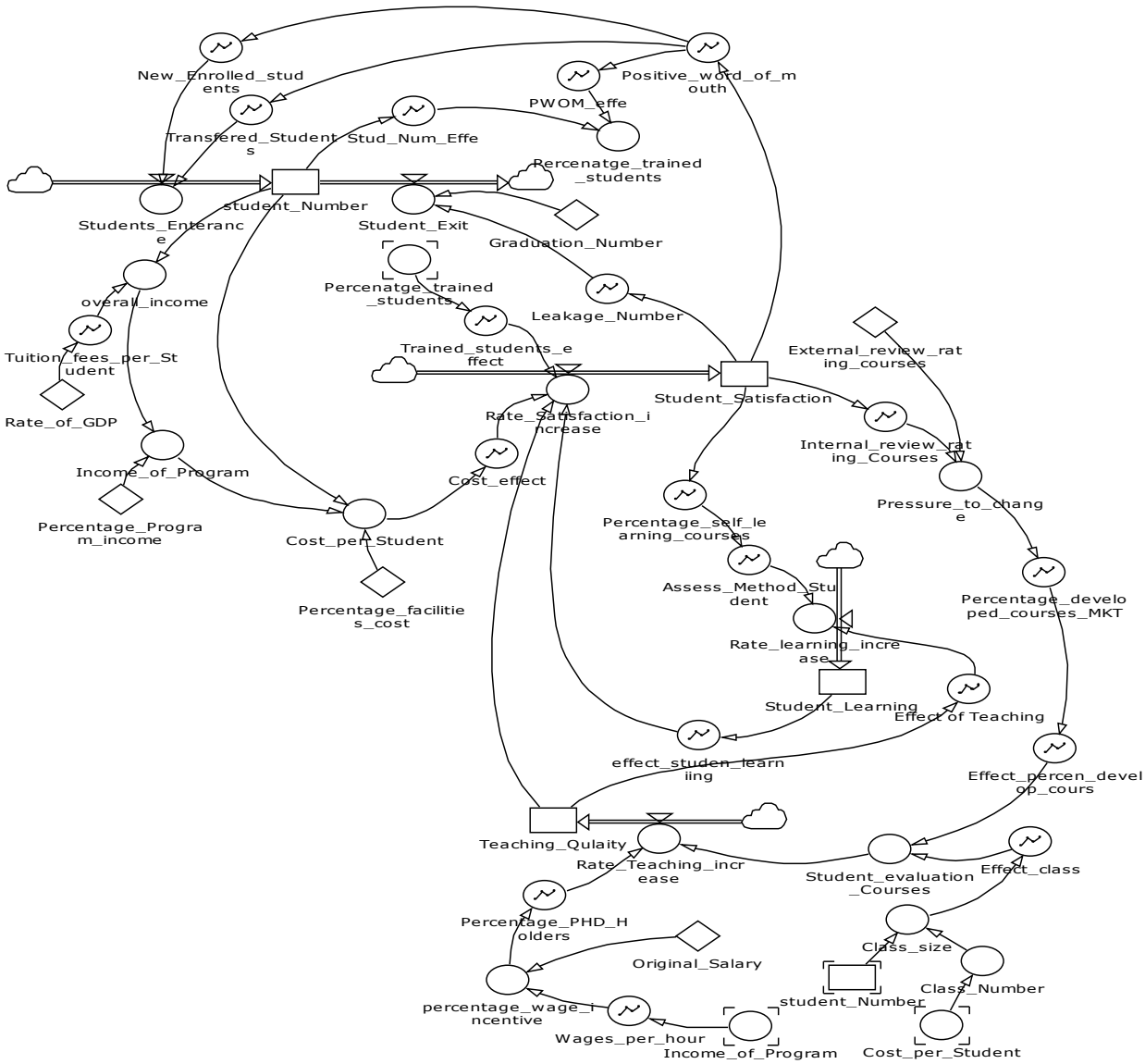

Figure 2. Stock and Flow Diagram of Dynamic Hypothesis

4. Data Analysis and Results

The data analysis using by the different tests is the fourth step in the system dynamics methodology. Several different tests were performed to test the validity and behavior of the model (Pejic-Bach and Ceric, 2007).

The dimensional consistency test was conducted to check whether the variables' dimensions in the system dynamics model correspond to the unit that can express the real variables of system. The results of this test indicated that the units of measurement of variables on both sides of the equation were equal. The extreme conditions tests were conducted to check whether the model behavior in extreme conditions matches the system behaviour in reality, in the same situation. The results indicated that the behaviour of the model is equal to the system behavior in reality.

The behavior sensibility test was conducted to identify the parameters with small values of changes, but they can cause a significant change in the model behavior as a whole. The objective of this test was to determine the parameters which would significantly affect system behavior, and they can thus be used to employ effective polices of system management. The results of this test showed that the facilities cost per student, quality of teaching, and percentage of Ph.D. holders were the most important factors that improved students' satisfaction by using small values of these factors.

What-if tests were conducted on the system dynamics model. The simulation method using series of what-if tests on the model was used to critically analyze how education management quality in the NAPs is affecting the students' satisfaction within EPUs. Thirty simulation scenarios were conducted to identify the best scenario to improve the students' satisfaction. The results of this test indicated that the improvements of percentage of Ph.D. holders, facilities cost per student, quality of teaching, and quality of student learning were the optimal scenario to enhance and improve the students' satisfaction by fourteen percent.

The validity test was made to verify the accuracy of the model. The real data that covered two years was used. The performance of the model is annually estimated. The results of the simulation model indicated that the values of students' satisfaction in the first and second year were equal to 0.59 and 0.62 respectively. Furthermore, the real values of students' satisfaction in the EPUs were equal to 0.61 and 0.65 respectively. This indicates that the system dynamics model was valid and corresponded to the real life situation. Therefore, it can be considered a very important model in the planning process of quality.

5. Discussion and Conclusions

Quality is one of the key strategies that has been adopted to face the international competition. The general direction of higher education is a creation of several developments globally to achieve a high degree of quality. The most important developments are the appearance of quality experts and their models, and the emanation of Total Quality Management (TQM) as a managerial philosophy (Teh et al., 2008).

Quality of education poses a great challenge because it deals with human beings. The industrial products are considered end goods, but education has no such end-product. The education process in universities is a transformational process that converts the inputs into performance and outputs (Cheng and Tam, 1997). Therefore, smooth internal processes in universities can positively affect teaching effectiveness and the learning experiences of students as one of the educational aims and outcomes (Kwek et al., 2010). As a consequence, students' satisfaction can be greatly improved in the HEIs.

Moreover, TQM as an important factor has a direct and positive effect on human improvements, like those concerning student satisfaction in the case of HEIs. It can lead to a high degree of commitment in the work environment of higher education. Consequently, the management and decision makers in the HEIs should be encouraged to positively implement TQM. According to the institutional features of higher education, the higher education system is characterized by complexity, unpredictability, diversity, and a value oriented system. Therefore, it was very necessary

to apply a dynamic approach that can meet these features. As a result, this research used the system dynamics methodology to overcome the challenges in higher education.

This research identified four CSFs of quality management in the HEIs that positively affect students 'satisfaction. They were percentage of Ph.D. holders, facilities cost per student, quality of teaching, and quality of student learning. The operational measures of TQM in HEIs in terms of CSFs would be beneficial to both decision makers and researchers. The decision makers may need to be aware of quality management success practices. They can use the CSFs of this research to evaluate the perceptions of TQM in their educational institutions.

6. Research Limitations and Future Research

The research was applied on ten NAPs of the engineering sector within two major public universities in Egypt. Future researchers can measure the effect of CSFs on students' satisfaction in other scientific sectors such as Medicine, the Sciences, and Pharmacy. Moreover, the effect of CSFs can be extended to include additional outputs of the higher education system; an example of which would be employment rate and intended learning outcomes. In addition, a comparative study can be performed between the NAPs and the traditional departments within the EPUs.

7. References

Arjomandi, M. Kestell, C. & Grimshaw, P. (2009). An EFQM Excellence Model for higher education quality assessment. *Proceedings of the 20th AAEE Australasian Association for Engineering Education Conference,* Adelaide, South Australia, 1015- 1020

Asif, M., Awan, M.U., Khan, M.K. and Ahmad, N. (2013). A model for total quality management in higher education. *Quality & Quantity*, 47, 1883-1904.

Azma, F. (2010). Qualitative indicators for the evaluation of universities performance. *Procedia-Social and Behavioral Sciences*, 2(2), 5408-5411.

Becket, N. and Brookes, M. (2008). Quality management practice in higher education What quality are we actually enhancing? *Journal of Hospitality, Leisure, Sports and Tourism Education*, 7 (1), 40-54.

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.

Bayraktar, E., Tatoglu, E. and Zaim, S. (2008). An instrument for measuring the critical factors of TQM in Turkish higher education. *Total Quality Management*, 19 (6), 551-574.

Cheng, Y.C., & Tam, M. (1997). Multi-models of quality in education. *Quality Assurance in Education*, 5 (1), 22-31.

Chen, S.H., Yang, C.C., Shiau, J.Y. and Wang, H.H. (2006). The development of an employee satisfaction model for higher education. *the TQM Magazine*, 18 (5), 484-500.

Elassy, N. (2015). Student involvement in the Egyptian quality assurance system. *Quality Assurance in Education*, 23 (2), 123-148.

Furst-Bowe, J. (2011). Systems thinking: Critical to quality improvement in higher education. *Quality Approaches in Higher Education*, *2* (2), 2-5.

Gould-Kreutzer, J.M. (1993). Foreword: System dynamics in education. *System Dynamics Review*, 9 (2), 101-112.

Heep(2017), [Online] www.heep.edu.eg/index.php/about/achievements.html [Accessed on January 2017]

Houston, D. (2007). TQM and higher education: A critical systems perspective on fitness for purpose. *Quality in Higher Education*, *13* (1), 3-17.

Joseph, N., Rajendran, R., Kamalanabhan, T.J. (1998). An instrument for measuring total quality management implementation in manufacturing-based units in India. *Int. J. Prod. Res,* 37 (10), 2201–2215.

Jackson, N. (1996). Internal academic quality audit in UK higher education. Part I: current practice and conceptual frameworks. *Quality Assurance in Education*, 4 (4), 37-46

Jackson, N. (1998). Internal academic quality audit in UK higher education. Part III: the idea of 'partnership in trust'. *Quality Assurance in Education*, 6 (1), 37-46.

Khanna, V.K., Vat, P., Shankar, R., Sahay, B.S. and Gautam, A. (2003). TQM modeling of the automobile manufacturing sector: a system dynamics approach. *Work Study*, 52 (2), 94-101.

Karapetrovic, S. and Willborn, W. (1997). Creating zero-defect students. *The TQM Magazine*, 9 (4), 287-291.

Kwek, C. L., Lau, T. C. & Tan, H. P. (2010). Education quality process model and its influence on Students' perceived quality. *International Journal of Business and Management,* 5 (8), 154-165.

Malhotra, N. K. (2010). Marketing Research: An Applied Orientation (6th edn). USA: Pearson Education.

Madu, C.N. and Kuei, C.H. (1993). Dimensions of quality teaching in higher institutions. *Total Quality Management*, *4* (3), 325-338.

Meirovich, G. & Romar, E. J. (2006). The difficulty in implementing TQM in higher education: the duality of instructor/student roles. *Quality Assurance in Education*, 14 (4), 324-337.

Mehrjerdi, Y. Z. (2013). A dynamic systems approach to weight related health problems. *International Journal of Quality & Reliability Management,* 30 (5), 571-589.

Ministry of Higher Education (MHE) (2010), Higher Education in Egypt Country Review Report [Online]http://s3.amazonaws.com/zanran_storage/mhespu.org/ContentPages/2473387763.pdf [Accessed on February 2016].

Mohamed, S. and Chinda, T., 2011. System dynamics modelling of construction safety culture. *Engineering, Construction and Architectural Management*, 18 (3), 266-281.

Morecroft J. & J.D. Sterman. eds. 1994. Modeling for Learning Organizations. Portland, OR: Productivity Press.

NAQAAE (2009, August). Accreditation Manual for Higher Education Institutions, National Authority for Quality Assurance and Accreditation in Education, [Online] http://books.naqaae.org/uni/manuals/higher_acc[Accessed on May 2014]

Owlia, M.S. & Aspinwall, E.M. (1997). Quality in higher education: a survey. *Total Quality Management,* 7 (2), 161-171.

Pejić-Bach, M. and Čerić, V. (2007). Developing system dynamics models with" step-by-step" approach. *Journal of information and organizational sciences*, 31 (1), 171-185.

Pounder, J. (1999). Institutional performance in higher education: is quality a relevant concept. *Quality Assurance in Education*, 7 (3), 14-22.

Quinn, A., Lemay, G., Larsen, P. and Johnson, D.M. (2009). Service quality in higher education. *Total Quality Management*, 20 (2), 139-152.

Raouf, A. (2004). Quality in higher education. *Proc. Pak. Acad. Sci,* 41 (2), 165–174.

Sahney, S., Banwet, & Karunes, S. (2004). Conceptualising total quality management in higher education. *TQM Magazine*, 16 (2), 145-159.

Schiuma, G., Carlucci, D. and Sole, F. (2012). Applying a systems thinking framework to assess knowledge assets dynamics for business performance improvement. *Expert Systems with Applications*, 39 (9), 8044-8050.

Schomaker, R., 2015. Accreditation and quality assurance in the Egyptian higher education system. Quality Assurance in Education, 23 (2), 149-165.

Sirvanci, M. B. (2004). Critical issues for TQM implementation in higher education. *Total Quality Management Magazine.* 16 (6), 382-386.

Sterman, J.D. (2000). *Business Dynamics: Systems Thinking and Modeling for a Complex World*. Boston: Irwin McGraw-Hill.

Supreme Council of Universities (SCU) [Online] http://www.scu.eun.eg [Accessed on May 2016]

Tari, J.J. (2006). An EFQM model self-assessment exercise at a Spanish university. *Journal of Educational Administration,* 44 (2), 170-188.

Teh, P.L., Ooi, K.B. and Yong, C.C. (2008). Does TQM impact on role stressors? A conceptual model. *Industrial Management & Data Systems*, 108 (8), 1029-1044.

Venkatraman, S. (2007). A framework for implementing TQM in higher education programs. *Quality Assurance in Education*, 15 (1), 92–112.

Wang, Y., Chou, C., & Yeo, G. (2013). Application and improvement of a system dynamics model to forecast the volume of containers. *Journal of Applied Science and Engineering,* 16 (2), 187-196.

Wiklund, H., Wiklund, B. and Edvardsson, B. (2003). Innovation and TQM in Swedish higher education institutions – possibilities and pitfalls. *TQM Magazine*, 15 (2), 99-107.

WorldBankGroup[Online]http://data.worldbank.org/indicator/SP.POP.TOTL/countries/EG?display=graph [Accessed on January 2016]