The Impact of Total Quality Management Using Data Mining on the Integrated Innovation Management in Smart Education

Mahmoud A. Ramadan [*], **Ahmed I. El Seddawy** [**], **Ahmed S. El Rawas** [***]

[*] Arab Academy for Science, Technology & Maritime Transport, Marketing Department
[**] Arab Academy for Science, Technology & Maritime Transport, BIS Department
[***] Arab Academy for Science, Technology & Maritime Transport, Finance Department

Abstract- Today, some twenty-two of the world's elite twenty-five research universities are located in one country. [29] He adds that it is not surprising that research on innovation has gained importance, it has become essential to understand why and how certain enabling environments encourage innovation and help optimize its various benefits. Among other things, research can identify how knowledge translates into innovative action and how diversity can drive positive change. In addition, one of the ways in which universities assure quality and acquire recognition in their home countries and abroad is through accreditation and certification. So, universities seek quality certifications differentiate themselves from the many institutions that are offering degrees and diplomas which have become commodities in the market economy. [29] say that Higher education institutions, and the people who study, teach and do research in them, are urged to place their intellectual capacities at the service of society, in order to defend ethical values such as peace, justice, freedom, equality and solidarity. And add development addresses the areas which are absolutely central to the future of most higher education institution. Consequently, the changing context for quality assurance innovation performance and enhancement in education presents both an opportunity and a challenge because it offers the possibility of integrating sustainable development into all quality systems.

Index Terms- TQM, DM, IIM, CIT, HE, WLI, Innovation, HD, SHE, WIL

I. Introduction

Higher Education is more than being just the cherry on the cake of education systems; it is a vital part of any sustainable development strategy. Higher education not only empowers people for their role in society and therefore is of vital importance to promote the sustainable development of our global community. It provides also the highly skilled individuals necessary for every labor market such as teachers, doctors, civil servants, engineers, humanists, entrepreneurs, scientists, and many more. [29] Besides increasing competitiveness of new rapidly growing economies, [20] adds Higher Education is a major driver of the global knowledge-based economy, since economic competitiveness depends, on the long run, on the quality of human resources. Need to enhance knowledge transfer and foster innovation and creativity. In higher education, the beginning of massification has deeply changed the traditional patterns of knowledge production, diffusion and application over the past two decades. In the wake of burgeoning enrolments from the 1970s to 1990s, demand has continued to rise and the world's student population could reach an estimated 150 million by [20]. This demand is varied in objective and scope, covering traditional academic and research based teaching and learning as well as specialized and more practically-oriented training. And Concerning the Universities, they are complex organizations with distinctive set of characteristics which have strong impact on culture of those institutions [20]. The race for the best: professors, researchers, students, international prizes and awards international rankings the centrality of research activities the quality of international partners creation of inter-university and international networks and the new hierarchy among universities. Therefore [25] say they are continually exploring new ways to foster graduates who possess a broad range of personal, social and professional capabilities. One such approach is evident in the spread of work-integrated learning 'WIL' practices which are gaining greater presence and propulsion within the higher education landscape. Within modernity, being an entrepreneurial university may be a necessity to survive; however, in [19] terms, there are options between ‗soft entrepreneurialism', which emphasizes creativity and the public good, and ‗hard entrepreneurialism', which is driven purely by the market and profit.

University leadership and management have major responsibilities to ensure that university governance accounts for resources, policies and infrastructure to support students, staff, industry partners and the diverse WIL contexts of social justice, cultural diversity, technological advancement and uptake, internationalization and professional accreditation commitments In higher education, these include: (i) demand; (ii) diversification of provision; (iii) changing lifelong learning needs; and (iv) growing Communication and Information Technology 'CIT' usage and enhanced networking and social engagement, both with the economic sector and with the community at large.

In higher education systems, this paper is aimed that offering sustainability of superior quality education among the most important goals for university strives to achieve using suitable proposed system. Moreover the purpose of this study is to increase the degree of quality performance and innovation management awareness, practice; As a result, in this paper it is mentioned about relationship between work-integrated learning

'WIL' and total quality management integrated innovation and, for the sustainability of higher education.

II. THE INTEGRATION BETWEEN TQM AND IIM

The quality tools that were used explicitly in the management of innovation processes, and will continue with a description of the quality tools that were primarily used for the management of quality, but unintentionally contributed to the management of innovation and they explained that many tools in strategic quality management, which are theoretically supportive to the management of innovation, actually do support the management of innovation to improve both the environment and their own competitiveness. At the same time, institutions of higher education are exploring means to integrate sustainability into curricula. And [25] list some the obstacles of the sustainable development of the higher education are following:

- Low efficiency of the HE system
- Long over duration of studies
- High dropout rates
- Lack of flexibility of study programs
- Recognition problems even within Europe
- Increasing social needs of an ageing population
- Adverse demography
- Slowdown of economic performance
- Public investment did not match the increase in number of students

In attempting to integrate sustainable higher education 'SHE', it is also necessary to address the focus; that is, a narrower or discipline-specific focus, or a broader or more cross-disciplinary focus. For example, sustainability can be integrated into higher education with a narrower focus, with respect to an individual program or school. Sustainability can also be integrated into higher education with a broader focus, with respect to cross-disciplinary or university-wide requirements. The generic matrix of options for integrating SHE is shown in figure 1 [18].

Figure 1: General matrix to integrate SHE

- The upper left quadrant or Quadrant 1 represents integration of SHE within existing structures and through a narrower, more discipline-specific focus. Illustrations of this type of decision include integrating sustainability into an already existing course in management as a new topic, case or module [15].
- The lower left quadrant or Quadrant 3 represents integration of SHE within existing structures, but through a broader, cross-disciplinary focus. Illustrations of this type of decision include integrating sustainability into one or more common core course requirements across the university [15].
- The upper right quadrant, or Quadrant 2, represents integration of SHE through a narrower, more discipline-specific focus, but through creating a new structure [15].

III. THE PERCEPTIVE OF THE INTEGRATED INNOVATION MANAGEMENT AND THE HD

Innovation is key in today's economy. Managing Innovation and New Product Development (NPD) processes is key to the delivery of higher quality and more creative solutions. Bringing new solutions to market on time and within budget requires the best tools available in Innovation Management. Innovations result from ideas, if they are implemented in new products, services and processes, which find real usage and thus penetrate the market [17].

(Innovation = Ideas+ New P/S+ market imp)

And [ ] adds that, Innovations don't always have to be completely new ideas. The term innovation rather means the implementation of something new and results in a noticeable improvement for the user.

They are characterized by a special characteristic, clear originality and a noticeable user benefit. Innovations are as a result qualitative new products, services, processes, structures, markets and cultures. And according to despite global uniformity in many areas of society, there exists no single answer as to what constitute the most appropriate systems, structures or policies for higher education, research and innovation. Systems of innovation may have varied scope international, regional, national or local and may have different organizational and institutional components: Organizations are formal structures that are consciously created with an explicit purpose, and are thus the principal players involved. And Institutions can be defined as frameworks of norms, rules, legislation and routines which constitute the rules of the game [17].

IV. THE TOOLS AND MODELS FOR DEVELOPING SUSTAINABLE HIGHER EDUCATION

There are different tools can used to develop sustainable higher education to improve. And will proposed model to improve the efficiency of TQM in universities to maximize integrated innovation management.

4.1. The Auditing Instrument for Sustainability in Higher Education (AISHE):

New tools have been developed for higher education; one of these tools is AISHE, Auditing Instrument for Sustainability in

higher education developed in the Netherlands by the Dutch Committee on sustainable higher education. The Auditing Instrument for Sustainability in Higher Education 'AISHE' is an instrument designed to assess the level of integration of sustainability in higher education institutions. AISHE is based on a model for quality management developed by the European Foundation for Quality Management 'EFQM', and enhanced by the Dutch Institute for Quality Management 'INK' for commercial use in companies.

This EFQM-INK model starts from the idea that, based on a set of criteria, an organization is situated in a certain development stage: (1) activity oriented, (2) process oriented, (3) system oriented, (4) chain oriented and (5) society oriented [ ]. Point out that the instrument can only be used in small groups on the level of single study programs, and the results may be biased by the subjective experiences of participants or the auditor's competences.
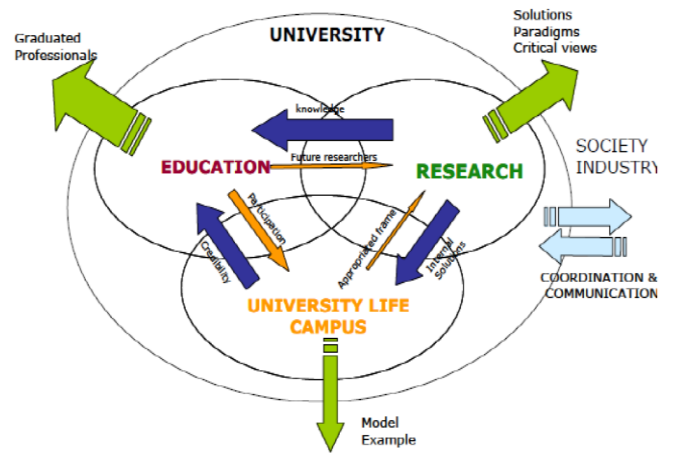
Table 1 gives an overview of different strengths and weaknesses of AISHE. Thus the evaluation of AISHE has led to the development of a new version of the instrument: AISHE 2.0, as a modular tool for each of the four roles of a university: education, research, outreach and operations. In order to achieve a holistic view, a fifth module is developed, the identity module.

Table 1: Strengths and weaknesses of AISHE

4.2. Learning and innovation frame work

Since 1996, the institution has developed and implemented two environmental plans, which have integrated research, education and operations in a comprehensive strategy. These plans are based on the model described in figure 2, which underlines the outputs that come from these three areas SD trained education professionals, SD solutions for research, and a SD role model for campus operations together with the flows that cross between them, which are synergetic effects that also have to be promoted. The balanced progress in the three areas provides mutual reinforcement for achieving the overall objectives of sustainable development in the university, as shown in figure 2 [13].

Figure 2: The role of UPC with respect to the environment and SD

	Strengths	Weaknesses
Structure	• EFQM • Process oriented • Flexible framework to use on an institutional level	• High level of complexity and abstraction • Focus on single study programs • Operations, research and outreach are underexposed
Process	• Interactive • Involvement of different stakeholders • Raise awareness, "aha-erlebnis" • Formulate desired situation	• Only usable in small groups • Motivation not always included • Emphasis on communicative aspects • "Light-initiatives" are not included
Results	• Define objectives and priorities • Easy to understand and interpret the results • Attractive and useful for decision makers	• Results depend on subjective experiences of stakeholders • Results depend on the auditor competence • No real indicators

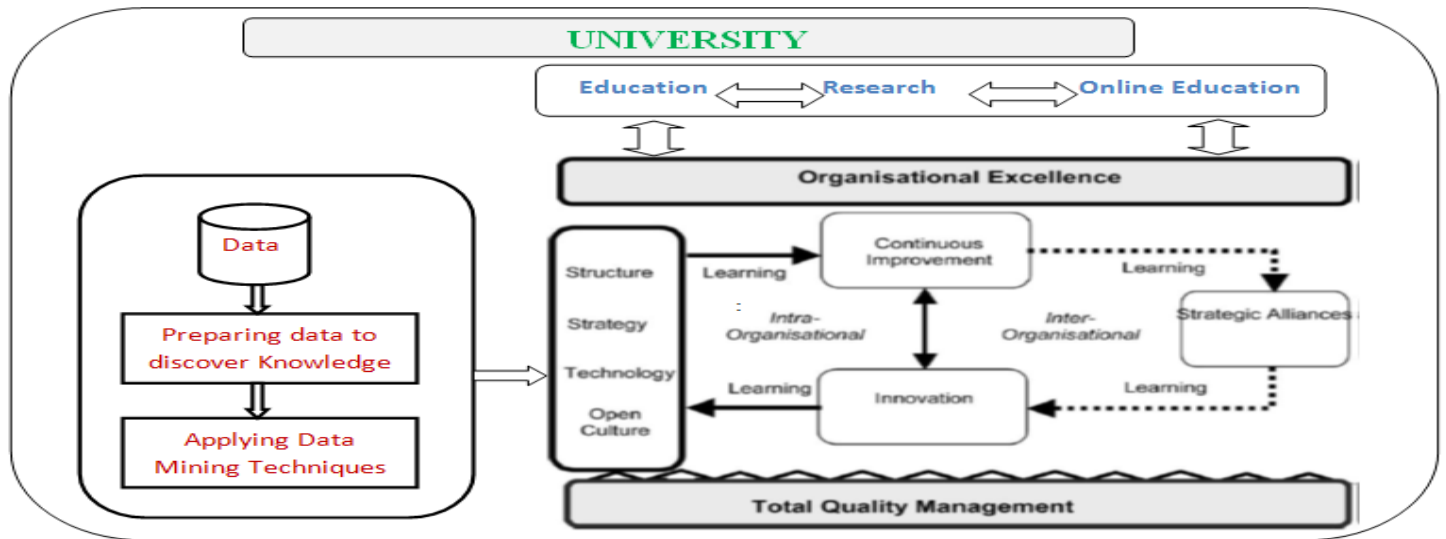V. THE PROPOSED MODEL FOR HIGHER EDUCATION USING TQM

Figure 3: The Proposed Model Using Data Mining

Our proposed system called Higher Educational Data Mining System 'HEDMS' concerns with developing methods that discover knowledge from data and usage come from educational system. The objective of HEDMS is to build a DM system for organizations for education system and aim to improve the integrated innovation management in higher education using TQM.

HEDMS consists of several components; data gathering, preparing data to discover knowledge, data pre-processing, using data mining techniques in sequences steps start with classification data, clustering data especially using K-mean 'K-M' algorithm and enhanced K-mean 'E-K-M' algorithm to set which best result, then post processing and finally get result and visualize result to create best decision to take a good decision for organization. HEDMS Shown in figure 2.

The proposed system will describe and mining higher education data to apply the best solution for improve the integrated innovation management using DM techniques such as classification, clustering, association rule mining and visualization of data.

Hardware for applying the HEDMS is a personal computer configurations with this Processor 3.2, Hard Disk 160 gaga, Ram 2 G and Monitor 17 Inch. Operating system is windows XP services pack 3. Several software tools have been used. The first is Microsoft Excel sheets 2007 and has been used for analysis and filtering data. Mat-lab version 6.5 has been used in data pre-processing and data classification. The last software is the WEKA which is a collection of java tools for DM written by staff at the University of Waikato, New Zealand.

The proposed system HEDMS using higher technologies to improve the integrated innovation management in higher education, by TQM of educational systems and after investigating the result for proposed system can support university with information to make decisions about education systems in order to improve the students' learning.

VI. CONCLUSION

Learning for sustainable development can be described as a joint search of individuals and organizations for knowledge and competence that enable them to deal with dilemmas in complex societal settings. That type of learning asks for authentic and open learning environments in which encounters with a diversity of disciplinary and stakeholder perspectives can take place. Most learning environments in traditional formal education do not optimally support that type of learning. Learning for sustainable development therefore constitutes a trigger for innovations in education.

In addition that quality management of innovation 'appears to be a subset of `innovation management 'that contributes sometimes explicitly, and in most cases implicitly, to the development of innovations. To improve quality in higher education truly contribute to sustainable development it is necessary that those running universities acquire an articulated vision of development. Where development is focused on their sustainability will be provided by making the necessary changes in future periods. In addition, conclude that Tools in strategic quality management do support the management of innovation. Creating the organizational conditions in which innovations can be developed; supervising and initiating innovation processes; producing innovation content; and implementing innovations in the primary processes of the organization.

On the other hand, if the focus of universities is not the formation of character and teaching people how to think deeper and broader than they so far have then they will produce individuals who can do things but incapable of dealing with all the major aspects of human existence Therefore according to EUROPEAN, If the business idea and/or innovation is developed inside the university, there will be basic problems as to intellectual property rights and to teachers' role as civil servants in some countries the law prevents teachers and researchers from

a working as entrepreneurs and exploiting innovations developed in the course of their work.

The greater the commitment to integrate sustainability into the curricula -in terms of more and/or new structures, and broader focus – the greater is the need for faculty resources and training in sustainability, as well as rewards for engaging in sustainability education and research Furthermore, employers and students must understand how the systems of which they are a part social, economic, and ecological function and are integrated. In order to accomplish this we need a significant segment of the learning opportunities for students to be structured to accomplish these outcomes. To do so will require significant changes in the curriculum and the pedagogy used to deliver that curriculum. These changes will only occur when large numbers of faculty have the knowledge, skills, resources, support, incentives, and disposition to change what and how they teach.

We have described how different data mining techniques can be used in order to improve the students' learning by supporting decision of teacher. All these techniques can be applied separately in a same system or together in a hybrid system. Although we have described the most general and well-known data mining techniques, there are as well other specific data mining techniques that are also used in e-learning such as classification, clustering and association rules. This technique is used for data cleansing, spotting emerging trends and recognizing unusually good or bad performers of students. In e-learning, outlier detection can be used for assisting instruction in the detection of learners' irregular learning processes. There are several benefits for HEDMS will effect on TQM such as;

- Facilitating critical conversations around the goals, objectives, student learning outcomes, underpinnings, and nomenclature surrounding;
- Developing partnership opportunities for collaborations to develop focused initiatives supporting sustainability education;
- Sharing opportunities for collaboration on ongoing projects and programs;
- Helping funding agencies and foundations better understand sustainability education and its significant role in improving higher education;
- Convening academic leaders for EfS discussion; and
- Identifying additional leverage points for forwarding the sustainability education agenda.

VII. FUTURE WORK

The future work will divide to tow steps of implementations; first focused on how we could develop the proposed approach and enhancing the approach by using DM classification technique to provide the universities best result and support high level of management with a good decision to increase the efficiency of TQM. Second focused on measuring this impact on TQM and the integrated innovation management in higher education

In the future, one of UPC's clearest goals is to improve its interaction with all stakeholders. Therefore, UPC will benefit from the outside worlds' interest in SD by developing a clear and efficient interface for stakeholders who clearly express their interest in collaborating with UPC in greater depth.

REFERENCES

[1] Merceron, A. andYacef, K., 2013, "Interestingness Measures for Association Rules in Educational Data". Proceedings of the first International Conference on Educational Data Mining, Canada, pp. 35-41.

[2] Merceron, A. and Yacef, K., 2009, "Educational Data Mining: a Case Study, School of Information Technologies, University of Sydney", Australia, Vol. 11, No. 5.

[3] Han, J. and Kamber, M., 2001, "Data mining: concepts and techniques", San Francisco, Morgan Kaufman.

[4] Merceron, A. and Yacef, K., 2004. "Mining Student Data Captured from a Web-Based Tutoring Tool: Initial Exploration and Results", Journal of Interactive Learning Research (JILR), Vol.15, No.4, pp. 319-346.

[5] Herin, D., Sala, M. and Pompidor, P., 2002, "Evaluating and Revising Courses from Web Resources Educational", In Int. Conf. on Intelligent Tutoring Systems, Spain, pp. 208–218.

[6] Chen, Han, and Yu. 1996. "Knowledge and Data Engineering Data mining: An overview from a database perspective", IEEE Trans, Vol. 30, No.3, pp. 8:866-883.

[7] Fayyad U., Piatetsky G. and Frawley W. J, 1991. "Press definition of KDD at KDD96". Knowledge Discovery in Databases, AAAI/MIT, Vol. 30, No.3, pp. 8:866-883.

[8] Gartner, February 2000, "Evolution of data mining", Gartner Group Advanced Technologies and Applications Research Note.

[9] Turban, E., Aronson J., Liang T. and Sharda R, 2007, "Decision Support and Business Intelligence Systems", eighth edition. Prentice Hall.

[10] Mostow, J., Beck, J., Cen, H., Cuneo, A., Gouvea, E., and Heiner, C., 2013, "An Educational Data Mining Tool to Browse Tutor-Student Interactions: Time Will tell",in: Proceedings of the Workshop on Educational Data Mining, pp.15–22.

[11] Mohammad H. and Jafar H, September, 2011. "Using Educational Data Mining Methods to Study the Impact of Virtual Classroom in E-Learning", IJDKP.

[12] Gabrijela D. and Dragana P. September, 2011, "The Use of Data Mining Methods For Analyzing And Evaluating Course Quality In The Moodle System", IJDKP, Vol. 47, No.3, pp. 17-27.

[13] Sonali A., Pandey G. and Tiwari M., 2010. "Data Mining In Education: Data Classification and Decision Tree Approach" Vol. 11, No. 5.

[14] Félix C., Alfredo V., Àngela N. and Francisco M., 2010, "Applying Data Mining Techniques to E-Learning Problems" Vol. 2, No. 6.

[15] Mamcenko, J., Sileikiene, I., 2013, "Analysis of E-exam Data using Data Mining Techniques", Vol. 10, No.7.

[16] Khedr, A. Elsayed, "Towards Three Dimensional Analyses for Applying E-Learning Evaluation Model: The Case of E-Learning in Helwan University", International Journal of Computer Science Issues (IJCSI), Vol.9: Issue: 4: No.1, July 2012, Pp.161-166.

[17] Amira M. Idrees, Ayman E. Khedr and Ahmed I. El Seddawy, 2014, "Performance Tuning of K-Mean Clustering Algorithm a Step towards Efficient DSS ", Vol. 2, No. 6.

[18] EUROPEAN COMMISSION, 2008. Enterprise and industry directorate-general promotion of smes competitiveness entrepreneurship best procedure project: entrepreneurship in higher education, especially in non-business studies‖ final report of the expert group

[19] Lambrechts, Ceulemans, 2011, Wim Lambrechts, Kim Ceulemans AUGUSTUS 2011, ―Sustainability in Higher Education: Experiences using the Auditing, Instrument for Sustainability in Higher Education‖ (AISHE), HUB RESEARCH PAPER 2011/11.

[20] Nazaré,2008, 30th annual EAIR forum , Copenhagen, 24 – 27 August 2008, Globalisation: Challenges and opportunities for higher education, Maria Helena Nazaré ,Universidad de Aveiro, Portugal Þorsteinsson 2010, Internationalization in higher education , Annual Nova seminar 2010 , Selfoss Iceland Björn Þorsteinsson, Agricultural University of Iceland, en: Lund University.

[21] A.D. Cortese, 2003, the critical role of higher education in creating a sustainable future, Planning for Higher Education, 31 (3), 15-22.

[22] AASHE, 2010, Sustainability Curriculum in Higher Education ,A Call to Action ―Association for the Advancement of Sustainability in Higher Education‖ ,1536 Wynkoop Street Suite B500, Denver, CO 80202 • Phone: 303.605.3537 • www.aashe.org

[23] Andy Johnston March,2007.HIGHER EDUCATION FOR SUSTAINABLE DEVELOPMENT Final Report of International Action Research Project

[24] R. Lozano, (2006a). Incorporation and institutionalization of SD into universities: breaking through barriers to change, Journal of Cleaner Production, 14, 787-796.

[25] Rands G., (2009), ―A principle-attribute matrix for sustainable management education and its application: the case for change-oriented service-learning projects‖, Journal of Management Education, Vol. 33 No. 3, pp. 296-322.Research and Knowledge/ International Centre for Higher Education Research Kassel at the University of Kassel

[26] Roorda N., (2010). Sailing on the winds of change. The Odyssey to Sustainability of the Universities of Applied Sciences in the Netherlands. PhD thesis, Maastricht University.

[27] Ross L. Chapman, Peter Charles Murray and Robert Mellor ,March 1996, ―Strategic quality management and financial performance indicators‖,InCITe (Innovation & Continuous Improvement Technologies) Research Group, University of Western Sydney, Macarthur, Campbe lltown, Australia

[28] Scott Leavengood and Timothy R. Anderson 2010, Best Practices in Quality Management for Innovation Performance‖. Proceedings of the International Convention of Society of Wood Science and Technology and United Nations Economic Commission for Europe – Timber Committee October 11-14, 2010, Geneva, Switzerland Paper WS-48 1 of 9

[29] Scott Leavengood and Timothy R. Anderson, Spring 2011,‖Quality + Innovation Adapting Quality Management Practices to Achieve Innovation Performance, Engineered Wood Journal •

[30] Shelly F. Fust & Lisa L. Walker 2007 ,‖ CORPORATE SUSTAINABILITY INITIATIVES: THE NEXT TQM?‖, Understanding emerging corporate sustainability practices through the lens of total quality management ,Copyright 2007 Korn/Ferry International

[31] Siemer, S., Elmer, S. en Rammel, C. ,2006, Pilot study: Indicators of an education for sustainable development. FORUM Umweltbildung, Wenen Shriberg, M., 2004, Assessing sustainability: criteria, tools and implications, in: Corcoran, P.B. en Wals, A. Higher education and the challenge of sustainability. Problematic, Promise and Practice. Kluwer Academic Publishers, Dordrecht/Boston/London, 71-86.

[32] Simpson, M., 2011, A 'one university' approach to ongoing quality enhancement, student satisfaction and risk minimization in workplace learning across geographically remote campuses of an Australian university. Paper presented at WACE Conference June 14-17, 2011, Philadelphia, USA.

[33] Steen, M. & Dhondt, S. (2010). Slow innovation. Paper presented at European Group for Organizational Studies Colloquium, Lisbon, 1-3 July 2010.

[34] Stengers, I. 2011, Another science is possible!‖ A plea for slow science. Faculté de Philosophie et Lettres, ULB 13 December 2011, Inaugural lecture: Chair Willy Calewaert 2011-2012 (VUB).

[35] STREBEL, H. UND HASLER, A. (2007): Innovations- und Technologies management 2007.

[36] TAGWERKER-STURM, M. (2010): Innovations controlling, 09.12.2010).

[37] Teresa Swirsk, 2012, Re-Imagining Work-Integrated Learning Through Slow Innovation In Higher Education, Maree Donna Simpson Charles Sturt University, Australia, Asia-Pacific Journal Of Cooperative Education, 2012, 13(4), 239-253 UNESCO Forum on Knowledge Systems

[38] V. Lynn Meek ,Ulrich Teichler, Mary-Louise Kearney, [Olsson and Mkandawire,2009] Berit Olsson and Thandika Mkandawire, Chapter 2 Compelling Rationale for a Copyright © 2009 UNESCO Forum on Higher Education

[39] Z. Irani , A. Beskese , P.E.D. Love, Total quality management and corporate culture: constructs of organizational excellence Technovation 24 (2004) 643–650.

AUTHORS

First Author – Mahmoud A. Ramadan, Arab Academy for Science, Technology & Maritime Transport, Marketing Department, Mahmoud.Ahmady@aast.edu

Second Author – Ahmed I. El Seddawy, Arab Academy for Science, Technology & Maritime Transport, BIS Department, Ahmed.AlSeddawy@aast.edu

Third Author – Ahmed S. El Rawas, Arab Academy for Science, Technology & Maritime Transport, Finance Department, AhmedAlRawas@aast.edu