Assessing the quality of multilingual open knowledge resources

Ivan Obradović*

Faculty of Mining and Geology, University of Belgrade
Đušina 7, 11000 Belgrade, Serbia

Ranka Stanković

Faculty of Mining and Geology, University of Belgrade
Đušina 7, 11000 Belgrade, Serbia

Roberto Linzalone
Dipartimento di Matematica, Informatica ed Economia, DIMIE
Università degli Studi della Basilicata
Via dell'Ateneo Lucano, 10 – 85100 Potenza, Italia
Institute of Knowledge Asset Management
IKAM Centro Studi&Ricerche
Via D. Schiavone, 1 – 75100 Matera, Italia

Marija Radojičić

Faculty of Mining and Geology, University of Belgrade
Đušina 7, 11000 Belgrade, Serbia

** Corresponding author*

Structured Abstract

Purpose – Acquiring of new knowledge is the core process not only in academic, but in entrepreneurial organizations as well. Information technology (IT) offers tools and resources for providing a knowledge acquisition continuum between them. Academic knowledge can be improved with best practice examples from enterprises, while entrepreneurial staff can keep pace with new academic knowledge within the lifelong learning paradigm. Open knowledge resources publicly available on the web play a pivotal role in this approach. In addition to that, Human language technology (HLT) has developed electronic tools and resources for supporting multilingualism in knowledge acquisition. The purpose of this paper is to offer an approach to quality assurance within a multilingual IT supported learning environment.

Design/methodology/approach – Following the 'Case study' methodology, we used an ongoing project, BAEKTEL *(Blending academic and entrepreneurial knowledge in technology enhanced learning)* as a 'polar type' for the research. The project is aimed at developing a network, and its technology infrastructure, for collecting and sharing open access knowledge assets among various types of institutions, both academic and entrepreneurial, in different countries. For quality assessment of these knowledge assets

metrics are needed, often obtained by a set of KPIs (Key Performance Indicators), which express the periodic achievement of operational goals of particular activities in quantitative form.

Originality/value – We propose a set of KPIs developed within BAEKTEL that can be used for quality assessment of multilingual open knowledge resources development, publishing and use. These KPIs can be modified and reused by other similar projects according to their specific needs. To make this adjustment easier we grouped the KPIs into several categories and discussed briefly each of them. In addition to that, we offer a template to be used as a guideline for KPI representation, including specific rules for their calculation.

Practical implications – KPIs offer a framework for efficient and structured assessment and subsequent improvement of open knowledge resources. Using IT to support acquisition of knowledge assets can result in significant overhead cost related to technology infrastructure, staff time and expertise. While being a large cost driver, the latter is also of key importance for quality of IT supported knowledge acquisition. KPIs can be helpful in preventing inadequate resourcing and financial management, which can compromise the quality of knowledge assets within the knowledge acquisition process. They allow for precise assessment of cost drivers to the management as a means for their minimization.

Keywords – Quality assurance, open knowledge resources, key performance indicators, e-learning.

Paper type – Academic Research Paper

1 Introduction

Acquisition of professional knowledge has traditionally been related to the educational process, with graduation from a university as the ultimate step in this process. However, nowadays it is widely recognized that there is a need for continuous professional education, or life-long learning. Among other things, this is the result of the fact that within contemporary organizations knowledge has become the asset of highest strategic importance. Continuous knowledge generation is a core process in many organizations, aimed at increasing the organization's cognitive capital through acquisition and creation of new knowledge within the organizational context. Thus acquisition of professional knowledge pertains to both academic and entrepreneurial organizations (Obradović and Stanković, 2014).

The exponential growth of available information and rapid development of information and communication technology (ICT) have resulted in qualitative changes in many aspects of modern society. Following this trend, innovations are also taking place in the field of managing knowledge assets. Among many innovations, ICT has offered opportunities for active learning within e-learning systems, with a flexible and modular architecture, which makes them easily adaptable and scalable. Within the e-learning paradigm free knowledge resources in the form of Massive Open Online Courses

(MOOCs) are now offered on the Internet. MOOCs are being developed within the widespread open educational resources (OER) movement, aimed at producing freely accessible learning materials, under an open license, to the rapidly growing community of self-learners (Stanković et al., 2014).

Large enterprises cross borders and spread over continents, involving people who speak different languages. According to the knowledge process wheel (Marr and Schiuma, 2001) at least three knowledge processes are directly affected by the use of different languages: knowledge generation (Rastogi, 2000; Alavi, 1997; Davenport and Prusak, 1998; Wiig, 1993), knowledge transfer (Davenport and Prusak, 1998; Wiig, 1993), and knowledge sharing (Tannenbaum and Alliger, 2000; Probst et al. 2002). Human language technology (HLT) relying on ICT provides electronic dictionaries and other language resources that can help in alleviating the problems in knowledge generation, transfer and sharing resulting from language barriers (Obradović et al., 2013).

As ICT and Internet opened new opportunities for organizations' knowledge generation, within multilingual environments, making available knowledge resources worldwide, often for free ('open'), the quality of these resources became an issue of concern. Namely, quality assessment of knowledge assets in a systematic way became critical. To achieve this goal measures are needed (Marr at al., 2004), often obtained by a set of KPIs (Key Performance Indicators), which monitor the performance of objectives, making them quantifiable. This paper outlines an approach to the development and use of KPIs in quality assessment of multilingual open knowledge resources.

2 KPIs within the e-learning environment

KPIs express the periodic achievement of operational goals of particular activities in quantitative form. They are relevant indicators, selected for monitoring the performance of a strategic objective, outcome, or key result area important to the success of an activity and growth of the organization overall. KPIs make objectives quantifiable, providing visibility into the performance of individuals, teams, departments and organizations and enabling decision makers to take action in achieving the desired outcomes (The KPI Institute, 2014).

KPIs are supposed to be “SMART”, that is specific, measurable, achievable, relevant and time-bound (Rozner, 2013):

- **S**pecific - the indicator should express what it is measuring, and how the measurement is obtained;
- **M**easurable - the indicator should be expressed as an objective value (e.g., # of trained persons, percentage of successful course completions), and reliable data must exist that can be straightforwardly collected;
- **A**chievable - the indicator should measure something within the project activity’s manageable control;
- **R**elevant - the indicator should measure the most important result of the activity;
- **T**ime-bound - data should be reported at regular intervals that allow monitoring and management decision making, with a deadline for achieving the indicator.

KPIs can be defined within any sector, activity, project, process, product or system. So they can be defined within an e-learning development project.

A key area of results in e-learning initiatives is quality assurance, with particular regard to the developmental stage (Academic Partnership, 2013). KPIs can serve as measures for quality assurance in the allocation of knowledge resources. In order to promote and support the definition of KPIs for the development of e-learning initiatives, we used an ongoing project, BAEKTEL (Blending academic and entrepreneurial knowledge in technology enhanced learning)[1] as a 'polar type' for the research, in accordance with the 'case study' methodology (Glaser and Strauss, 1967; Eisenhardt, 1989; Yin, 1981; Yin, 1993). The project BAEKTEL is aimed at developing a network and its technology infrastructure, for collecting and sharing knowledge assets, freely available, among various academic and entrepreneurial institutions in several different countries.

Despite of a large number of e-learning projects developed so far, in many countries, BAEKTEL's polar features make it theoretically consistent for the definition of KPIs for quality assurance in a multilingual *open knowledge* setting. BAEKTEL, in fact, collects educational materials, like: lectures, exercises, case studies, case examples, tests, in several different forms: video, audio, text, images, questionnaires, etc. Institutions and companies from six countries are co-developing the system project (Serbia, Bosnia and Herzegovina, Montenegro, Slovenia, Italy, Romania), and producing educational materials in various languages: Serbian, English, Russian, Italian. It is also remarkable that the e-learning project BAEKTEL blends different knowledge types, as it combines academic knowledge content with industry knowledge content. This attempts to overcome the traditional constraints of *explicit knowledge* and *tacit knowledge*, (Polanyi, 1966) where the first is codified and learnable in educational settings (universities, schools, etc.), whilst the second is not codified, learnable only in operative settings, through continuous practice (Enterprises, Public services, etc.) (Nonaka and Takeuchi, 1995).

Quality assurance activities related to monitoring and control of this project meant, in particular, setting up of a board of KPIs dealing with the allocation of resources for e-learning development in general, as well as with specifics related to development and publishing of:

- open knowledge resources, or open educational resources (OER) as they are more often called,
- multilingual knowledge resources,
- multi-nature knowledge resources (explicit vs. tacit).

The fact that OER are shared openly offers a great potential for the improvement of their quality, accessibility, and effectiveness of education. OER transparency motivates the institutions that publish them and teaching staff who produces them to take special care of their quality. Traditionally, academics tend to protect their intellectual capital, but OER openness exposes their teaching to peer view (Uvalić-Trumbić and Daniel, 2014).

[1] *www.baektel.eu*

In determining the KPI values, a dual evaluation cycle is recommended when appropriate, with both user evaluation and expert validation. This is basically in accordance with SEVAQ+,[1] a European-wide initiative for quality assessment in e-learning. The approach is focused on three domains according to the EFQM model of excellence[2] (European Foundation for Quality Management, 1999): resources, processes (activities) and results (learning objectives achieved, effects of the experience on the learner, some measure of the transfer in the workplace).

In the following section we outline the basic factors for determining a list of KPIs as indicators that can be used for qualitative evaluations of knowledge resource usage. However, in each specific case, users can modify the proposed indicators to fit their needs, discarding the ones that are not necessary.

3 Cost indicators and KPI categories

In this section we first outline the most important cost drivers (resource needs) for online learning. KPIs allow for precise assessment of these cost drivers which can be used by the management as a means for their minimization. Thus, KPIs can be helpful in preventing inadequate resourcing and financial management, which can compromise the quality of knowledge assets within the knowledge acquisition process.

In order to make the selection and modification of KPIs for a specific purpose of knowledge resource usage easier we grouped them in three categories: indicators of development, indicators of effectiveness and impact and indicators of assessment, and briefly discuss each of this group.

The KPIs proposed within each category are mostly tailored to the needs of the BAEKTEL project that we used as the 'polar type' in our research. The project is aimed at building a network of open knowledge resource platforms based on edX[3], an open source software for developing OERs. Each partner institution (PI) within the project is developing resources on its edX node, while metadata about all resources from the entire network are stored on a common portal (BMP – BAKTEL metadata portal) for easier access thorough search and browse facilities. As open knowledge resources can be in different languages the BMP portal also offers support for multilingualism within the network.

Finally, aiming at alleviating the systematization of KPIs in general, we offer a template to be used as a guideline for KPI representation including specific rules for their calculation.

3.1 Resource allocation and cost drivers

One of the key issues in e-learning is what resources should we allocate to developing quality knowledge resources? It has been widely accepted that inadequate resourcing and

[1] *http://sevaq.efquel.org*
[2] *http://www.efqm.org/the-efqm-excellence-model*
[3] *https://www.edx.org/*

financial management can compromise the quality of knowledge resources and e-learning in general (Frydenberg, 2002). There are five main cost drivers in e-learning: planning, design and development, delivery, maintenance, and overheads (Contact North, 2014).

A significant overhead cost is one of technology infrastructure, whereas staff time and expertise is a large cost driver, but also a key resource for quality online learning. The list of most important factors driving knowledge resource production costs is as follows:

1. Working hours used for knowledge resource development and preparation;
2. Working hours used for knowledge resource monitoring and supervision;
3. Number of knowledge resource learners, especially the ratio of instructors to learners ('class' size);
4. Remuneration of knowledge resource producers and instructors;
5. Method of knowledge resource design, development and delivery (individual vs. team work);
6. Type of knowledge resource produced (e.g. recorded lecture, best practice, case study, exercise, guidelines, lesson, module, monitoring and evaluation technique, policy brief, portal, promotional material, reference material...);
7. Technology used for knowledge resource publication (electronic document, slides, website, audio, video);
8. Assessment of knowledge resource and its outcomes (the impact of this factor is measured by a separate category described in detail later);
9. Overhead costs (IT infrastructure, telecommunications costs, marketing, public relations, institutional administrative costs).

3.2 Indicators of development

The first category of KPIs is related to development of the network and each node in particular. These KPIs are supposed to offer an insight in the growth of available knowledge sources. All KPIs in this category are calculated periodically, for given reporting time periods, per partner institution and per subject domain[1] and/or gender, where applicable. The suggested core set of KPIs related to development is composed of the following:

1. Volume of created open knowledge resource content, per PI and subject domain
2. Volume of metadata on BMP, per PI and subject domain
3. Number of resource creators, per PI, subject domain and gender
4. Number of users (learners), per PI, subject domain and gender
5. Number of administrators, per PI and gender
6. Number of trained persons for open knowledge resource management, per PI and gender
7. Volume of entries in multilingual dictionary: per PI, subject domain and language

[1] *According to the OECD Frascati Field of Science and Technology Classification http://www.oecd.org/science/inno/38235147.pdf*

Figure 1. depicts the data used for calculating the KPI number 6 on the above list. On the chart the 11 institutions forming the BAKTEL consortium are represented by their acronyms (e.g. UB – University of Belgrade, USB - Università degli Studi della Basilicata, etc.), with the number and gender of trained persons for open knowledge resource management from each of them.

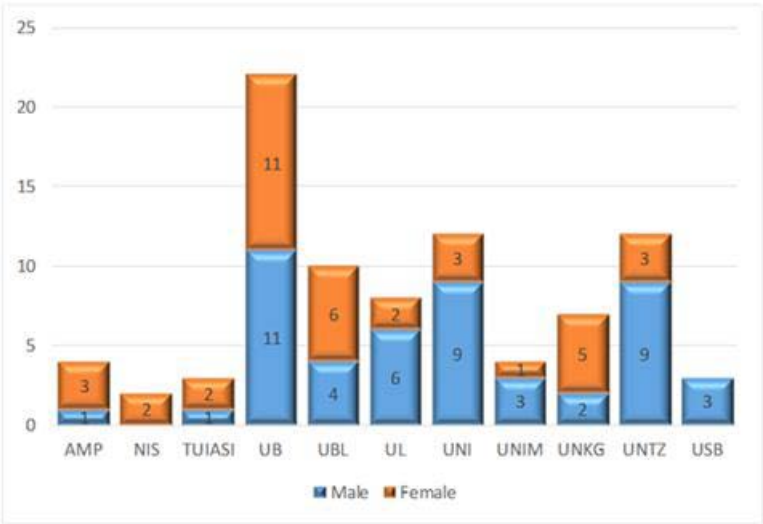

Figure 1. Trained persons for open knowledge resource management, per PI and gender

3.3 Indicators of effectiveness and impact

Development does not necessarily imply effectiveness and wider impact. For example, the number of users of an open knowledge resource may grow, but if the resource is not used effectively the growth of the number of users can be misleading. A typical example is a MOOC, an open online course: if a high number of users enroll in the course, but a small number of them complete it, then the effectiveness of this open knowledge resource is low. KPIs in this category are also calculated periodically, for given reporting time periods, per subject domain and/or gender, where applicable. In the second category of KPIs for assessing the effectiveness of teaching and learning using open knowledge resources and their impact, the KPIs within the core set are:

1. Learner attendance: time spent by learners on open knowledge resource usage, per PI, subject domain and gender
2. Learner retention: number of learners that completed the schedule envisaged by the open knowledge resource, per PI, subject domain and gender
3. Number of visitors of public open knowledge resource project websites[1]

[1] *Using Google Analytics http://www.google.com/analytics/*

4. Number of references (e.g. conference presentations, journal articles or interviews) related to the open knowledge resource project and disseminated via conferences, TV, radio, web, forums, round tables, etc.
5. Number of participants at open knowledge resource project dissemination events, per PI and gender
6. Number of best practice references related to the open knowledge resource project

3.4 Indicators of assessment

As acquisition of new knowledge is a complex and delicate process (Papić and Aleksić, 2012) various kind of indicators that can help in assessment of knowledge resources are necessary. To that end the third group of KPIs is defined related to peer and external assessment.

1. Number of open knowledge resources evaluated with the highest grades
2. User assessment: quality of created open knowledge resources and their easiness of use assessed by user feedback questionnaires
3. Assessment of the quality of created open knowledge resources by entrepreneurial partners
4. Assessment of the quality of created open knowledge resources by external reviewers

3.5 KPI template

When KPIs are defined, in order to secure their uniformity, it is useful to have a specific set of attributes that need to be specified for each KPI. To that end, we are proposing a template to be used as a guideline for KPI representation including specific rules for their calculation (Rozner, 2013). Table 1 presents this template for the list of selected KPIs. Needless to say, it can be modified according to specific user needs.

Table 1. KPI template:

	Element	**Description**
1	KPI title	Exact title of the KPI
2	KPI description	Description of the KPI including a description of the target population
3	KPI rationale	Rationale for the measurement of the KPI - the reason for the introduction of KPI
4	KPI target	Indicate the target for the KPI – a target should be set for each KPI to inform on the progress towards an acceptable level of performance (target - maximum value)

5	KPI calculation	Indicate how the KPI will be calculated including information on the denominator and numerator and information on the inclusion and exclusion criteria, e.g.: - the denominator is the target population, and includes all services, users, or events that qualify for inclusion in the measurement process - the numerator is the subset of the target population that meets the criteria as defined in the indicator
6	Data source(s)	Indicate what data source(s) will be used for the KPI; for example, data sources include LMS database, account administrative databases, metadata portal records, attendance lists and meeting agendas, and/or survey data
7	Data collection frequency	Indicate how often the data to support the KPI will be collected
		□Monthly □Quarterly □Bi-annually □Annually
8	KPI monitoring	Indicate how often the KPI will be monitored and by whom
9	KPI reporting frequency	Indicate how often the KPI will be reported
		□Monthly □Quarterly □Bi-annually □Annually
10	Reports related to KPIs	Indicate where the KPI will be reported, for example, the KPI may be reported in annual reports, annual service plans, quarterly performance reports, budget requests, or others.
11	Limitations	Indicate any factors or characteristics of the indicator or its data elements that might compromise the accuracy of results
12	Additional Information	Provide any other information relevant to the KPI

4 Conclusions

The impact of ICT in all segments of the society resulted in innovative approaches to managing knowledge assets. However, only purposeful use of ICT, which requires quality assurance of knowledge resources, can have a positive impact on improving the knowledge acquiring process. The concept of quality in e-learning is complex and several different benchmarks for quality standards have been defined and tested in various contexts (Uvalić-Trumbić and Daniel, 2014). This paper presented a list of KPIs that have been developed for monitoring the performance of a multilingual open knowledge resource system, BAEKTEL, making the level to which the system goals have been realized quantifiable. The approach to quality assurance outlined within this paper might prove useful, with possible modifications, for other similar projects

The 'case study' research conducted, although based on the sampling of an ongoing project, allowed to distill some strategic as well operative guidelines, useful for an effective assessment of quality in e-learning initiatives. The *open*, *multilingual*, *multinature* knowledge setting of the BAEKTEL project, made it a consistent and

challenging field of investigation for the quality assessment. Some insights can be enucleated, as follows.

In order to assess the quality of an e-learning project development, it is recommended to follow a gradual approach to the measurement of KPIs. Namely it is coherent to proceed in order with the identification/definition of: quality dimensions, quality drivers, KPIs, metrics. A hierarchical structure underlies the definition of the quality indicators, moving from the top (quality dimensions) to the bottom (metrics).

The setting of 4 dimensions is then possible. They might cover the following areas: knowledge resource allocation and cost, development of knowledge, effectiveness and impact of knowledge, evaluation of the quality assessment (metaevaluation).

A set of 26 performance *knowledge* drivers is suggested to consider, as they underpin the definition of as many KPIs.

Once a KPI has been identified/defined a detailed, even schematic, description of the indicator has to be drawn. The use of a standard template forces in the clear and complete definition of the meaning, the metric, the frequency, the source, the limitation in use, of a KPI, supporting a responsible and effective use of them, as well as providing a guide in the design of the KPI itself.

Specific performance indicators related to: openness, multilingualism, blending of academic/expert knowledge, in all the 4 dimensions, have to be defined. Some benchmark indicators, can be:

- *Type of knowledge resource produced* (e.g. recorded lecture, best practice, case study, exercise, guidelines, etc.);
- *Volume of created open knowledge resource content*;
- *Number of open knowledge resources evaluated with the highest grades;*
- *Quality of created open knowledge resources and easiness of use;*
- *Quality of created open knowledge resources by entrepreneurial partners.*

Further development of the research will focus on the analysis of results obtained by the proposed KPIs and their possible effects in improving open knowledge resources and the entire system. Further development of our approach will involve development of Index KPIs, that is, indexes of multiple KPIs. Namely, KPIs might often actually be measured in completely different units and in such cases Index KPIs are used for normalization of underlying KPIs and for providing a single score, akin to, for example, the Health Index, often used in the public sector, which is composed of multiple health related KPIs.

References

Academic Partnership, (2013), A Guide to Quality in Online Learning, 600 N. Pearl St. Suite 900, Dallas, TX, http://www.academicpartnerships.com;

Alavi, M. (1997), "I KPMG Peat Marwick U.S.: One Giant Brain", Harvard Business School, Vol. 9, No. 3, pp. 97-108.

Contact North, (2014), How to Assess the Costs of Online Learning in Post-secondary Education, Ontario Online Learning Portal for Faculty & Instructors, http://www.contactnorth.ca/tips-tools/how-assess-costs-online-learning-post-secondary-education.

Davenport, T. H. and Prusak, L. (1998), Working knowledge: How organizations manage what they know, Harvard Business School Press, Boston.

Eisenhardt, K.M. (1989), "Building theories from case study research", Academy of Management Review, Vol. 14, No. 4, pp. 532-550.

EFQUEL, (2014), Self-evaluation of quality in technology-enhanced learning, http://sevaq.efquel.org/

European Foundation for Quality Management, (1999), The EFQM Excellance Model, EFQM, Bruxelles;

Frydenberg J, (2002), Quality Standards in e-Learning: A Matrix of Analysis, http://www.irrodl.org/index.php/irrodl/article/view/109/189.

Glasser, B.G. and A.L. Strauss (1967), The Discovery of Grounded Theory Strategies for Qualitative Research, Aldine, Chicago.

Marr, B. Schiuma, G. (2001): Measuring and Managing Intellectual Capital and Knowledge Assets in New Economy Organisations, in Bourne, M. (ed.), Handbook of Performance Measurement, Gee, London.

Marr B., Schiuma G, Neely A, (2004), "Intellectual capital – defining key performance indicators for organizational knowledge assets", Business Process Management Journal, Vol. 10 No. 5, pp. 551-569.

Nonaka, I. and Takeuchi, H. (1995), *The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation*, Oxford University Press, New York, NY.

Obradović I, Stanković R, Prodanović J & Kitanović O, (2013), "A TEL Platform Blending Academic and Entrepreneurial Knowledge", Proceedings of the Fourth International Conference on e-Learning, eLearning, pp.65-70.

Obradović I, Stanković R, (2014), "Using technology for knowledge transfer between academia and enterprises", Proceedings of IFKAD 2014 - International Forum on Knowledge Asset Dynamics, pp. 792-805.

Polanyi M., (1966), The Tacit Dimension, Anchor Books, New York, NY

Papić, Z. and. Aleksić, V. (2012) Metodika nastave tehničkog i informatičkog obrazovanja. Tehnički fakultet Čačak, pp. 84.

Probst, G., Raub, S., Romhardt, K. (2000): Managing Knowledge, John Wile y & Sons, Chichester

Rozner S, (2013), Developing Key Performance Indicators, A Toolkit for Health Sector Managers, https://www.hfgproject.org/wp-content/uploads/2014/10/03-Developing-Key-Performance-Indicators.pdf.

Rastogi, P. (2000). "Knowledge management and intellectual capital: The new virtuous reality of competitiveness", Human Systems Management, Vol 19, No 1, pp. 39-49.

Stanković R, Kitanović O, Obradović I, Linzalone R, Schiuma G, Carlucci D, (2014), "Using Metadata for Content Indexing within an OER Network", Proceedings of the Fifth International Conference on e-Learning, eLearning 2014, S Belgrade Metropolitan University, Belgrade, Serbia, pp. 49-54.

Tannenbaum, S. I., and Alliger, G. M. (2000). Knowledge management: Clarifying the key issues. Austin, Tex.: Rector Duncan & Associates.

The KPI Institute, (2014), Smart KPIs, http://www.smartkpis.com/key-performance-indicator-KPI.

Uvalić-Trumbić S, Daniel S J, (2014), A Guide to Quality in Post-Traditional Online Higher Education, Academic Partnerships.

Wiig, K., (1993) Knowledge Management Foundations: Thinking about Thinking – How Organizations Create, Represent and Use Knowledge, Schema Press.

Yin, R.K. (1981) "The case study as a serious research strategy", Knowledge: Creation, Diffusion, Utilization, Vol. 3, No. 1, pp. 97-114.

Yin, R.K. (1993) Applications of Case Study Research, Sage, Newbury Park.