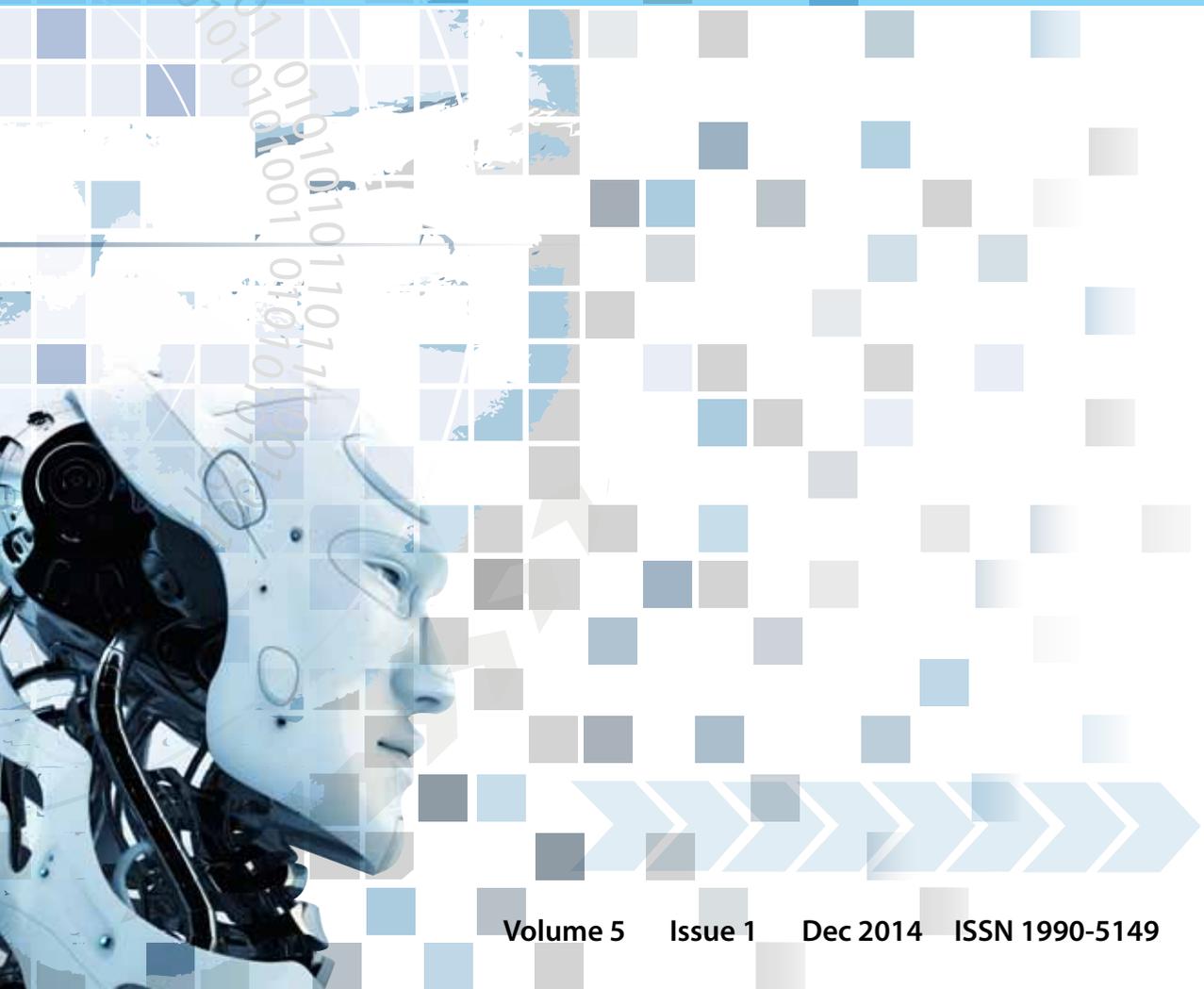




Sultanate of Oman  
Ministry of Higher Education

# OMANI JOURNAL OF APPLIED SCIENCES

Bi-Annual Refereed Scientific Journal



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# **Omani Journal of Applied Sciences (OJAS)**

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**OMANI JOURNAL OF APPLIED SCIENCES (OJAS)**  
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The Omani Journal of Applied Sciences (OJAS) provides a forum for researchers and practitioners to discuss, analyze and shape current issues related to their specialization as well as from a multidisciplinary perspective. The journal has an applied research orientation, and includes both quantitative and qualitative empirical studies on contemporary issues and debates that will encourage and motivate future research as well as providing the foundations for the application of research findings. The journal adopts a region-specific as well as an international orientation with a comparative approach.

**Aims of the journal:**

1. Publishing academic research, and scientific studies in the fields of applied science in Communication, Design, Information Technology, International Business, Engineering & English language.
2. Reviewing discussions of new issues related to higher education and scientific research.
3. Developing scientific research and encouraging academic specialists to carry out scientific research.
4. Monitoring important scientific activities such as conferences symposiums, workshops and surveying and commenting on dissertations.
5. Reviewing and commenting on recent publications.

The Omani Journal of Applied Sciences (OJAS) is published Bi-annual. Special issues of the journal devoted to topics in vogue will also be published occasionally. Papers, case studies, etc are invited for submission by prospective authors.

All papers are internationally refereed and should represent the results of original research which have not previously been published. Contributors should refer to the Instructions to Authors when preparing their manuscripts. It is also the responsibility of the contributors to obtain permission from authors for data or quotations attributed to the latter. Views expressed in the articles are the sole responsibility of the contributors.

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**Bi - Annual Refereed Scientific Journal**

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## A NOTE FROM THE GUEST EDITORS

Dear Readers and Contributors

Greetings and a warm welcome

It gives us immense pride and pleasure to place the volume 5, Issue 1 of the Omani Journal of Applied Sciences (OJAS).

We naturally think of higher education institutions as places of teaching and learning. However, throughout the nation and world, the economic engine function of colleges and universities is becoming increasingly visible.

The requisite growth of higher education has stimulated an explorer's mentality among college deans and administrators. Venturing into new frontiers for new buildings—spaces for research in growth areas, such as Biotechnology, Engineering, Information Technology, Communication, Design and International Business Administration—is in vogue. These new developments can bring more subcontracts, more jobs, more businesses, and overall greater local spending. In many ways, the economic engine function completes the picture of research, teaching, and service. It is the combination of all of those dimensions, focusing on fulfilling the mission of institutions.

The Scientific Committee received several high quality papers for this issue of OJAS from the researchers across globe. After being reviewed by independent referees, the OJAS Editor, who chose the 6 best research papers for publication in this issue. The selected research papers covered topics related to specific areas of Applied Sciences. We sincerely hope that this issue will provide a fair overview of research topics and that the readers will benefit from reading these papers as much as the entire team of CAS journal did.

The current issue of OJAS includes sixth research articles and one summery about Tourism Investment Conference that was held in Muscat from 22 to 23 December 2013.

The first paper is entitled "*Roadmap for recovery amid challenges facing Oman tourism*" is written by Dr. Sedat Yuksel. It describes and analyses the challenges of Oman tourism and explains how Omani Government can overcome these challenges in view of World Tourism Organization Roadmap. The study suggests that the Omani Government has to rethink the existing growth models and embrace the principles of sustainable development and the transformation to the green economy.

The second paper is entitled "*Protection mode for data transmissions between*

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*mobile databases*". The paper which is co-authored by Dr.Ziyad.T.Abdul-Mehdi and Dr.Mohammad H. Al-Taei explores four mobile transaction management models which are widely used. The comparison between these models shows that all of them work without security transmission between Mobile Host (MH) and Base Station (BS). The study proposed a new mode to keep data transmission at protected level.

The third paper is entitled "*Academic Advising in Higher Education Institutions in the Sultanate of Oman-The Case of Ibri College for Applied Sciences*". The study is co-authored by Dr.Jehad Mahmoud AlKhalaf Bani-Younis and Dr.Ahmad bin Juma Al-Riyami. The study provides a general description of the academic advising process and analyses the most serious problems pointed out by the students in this respect. It sheds light on the problems encountered by students on academic probation and discusses a number of suggested solutions. The study suggests improving the academic advising process, and forming a central committee at the Directorate General level.

The forth paper is entitled "*Strategic partnership between Business Education and Industry*" which is co-authored by Dr. Suhaila M. Abbas and Dr. Mathew Philip. The paper focuses on the strategic partnership between business education and labor market by the implementation of effective mechanisms of cooperation between business schools and industry. The study suggested that industry-business school engagement is one of important strategy to develop both the academic institutions and the labor market.

The fifth paper, entitled "*Significant Determinants of ICT Adoption for Higher Education Faculty in the Arabic Culture: the Case of Sultan Qaboos University, Oman*" is authored by Dr.Said Rashid Al- Senaidi. The author employs Rogers' diffusion of innovation theory as a framework to investigate the salient factors influencing Informational and Communication Technologies (ICT) adoption in the Omani cultural context using the multivariate approach. The study suggested that teaching traditional classes has an adverse impact on ICT adoption. Conversely, teaching blended classes is significantly related to ICT use. This indicate that Rogers' diffusion of innovation theory is generally supported, but needs to be refined and modified for ICT adoption in the Omani higher education context.

The sixth paper is entitled "*Multipole Mixing Ratios  $\delta$  of  $\gamma$ - Transitions in 95 Sr Isotopes*" and is authored by Dr. Jabbar Al Saadi who calculates the  $\delta$ - value for gamma transition between the energy levels of 95 Sr Isotope by using the Constant Statistical Tensor (CST) method. The studies confirm the validity of this method and show a good agreement and give more prediction than previous workers.

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This issue also provides a brief summary about “Oman’s 1<sup>st</sup> Conference on Tourism Investment” which was held at Al Bustan Palace Hotel during 22 - 23 December 2013.

We would like to gratefully acknowledge the time and support of the Ministry of Higher Education, contributors, referees, members of the Academic Publications Governing Board, Editorial Board and International Advisory Board in all our endeavours, which have inspired us to reach a higher level in the scientific research.

We invite your valuable feedback and constructive suggestions for further improvement of OJAS in the coming years. Finally, we wish you a happy and prosperous New Year to all our esteemed readers, contributors, patrons and well wishers

With best Regards,

***Professor.Hussein Iskef***

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## Brief Profile of the Contributors

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He has published articles in International journals and conferences on topics in database systems, Transaction management, Security replication, e-government and information ethics. Dr. Ziyad is a member of the Evaluation Committee and Board editor in IETECH (International Journal for Engineering and Technology) as well as member for paper evaluatoing committees for many international conferences, such as international conference Science of Electronics, Technologies of Information and Telecommunications (SETIT'2014), M2USIC2007 and many other international conferences.

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**Dr. Mohamad Hameed Ahmed Al-Taei** earned his PhD. Degree in Computer Applications ( Telemedicine ) from Zheji-ang University, China in 1999, M.Sc. Degree in Computer Science ( Computer Arithmetic) from Mosul University, Iraq in 1990, and B.Sc. Degree in Mathematics from Mosul University in 1984.



He worked as Head of Information Technology Department in Sohar College Applied Science, Oman (2010-2012). Currently he is an Assistant Professor in the same College .From 1999 to 2008, he worked as an Assistant Professor in the faculty of Information Technology in Applied Science University and Zarka Private University in Jordan. From 1991 to 1996 he worked as an Assistant Lecturer in Mosul University , Iraq.

Dr. Al-Taei has published articles in International journals and conferences on topics of Computer Arithmetic, Computer Applications and Telemedicine applications.

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**Dr. Jihad Mahmoud Al-Khalaf Bani - Younis** is the Dean in Ibri College of Applied Sciences. He has a Doctorate from Uzbekistan Academy of Science in 1996. Since then he has constantly been working in the field of academics striving for the quality society.

He is an expert in the planning and management of innovative teaching practices focussing in particular on the areas of science and engineering education, training and administration.

He has been involved actively in research having more than 40 publications to his credit. He is often invited as a speaker or expert at International Conferences

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**Dr. Ahmed Juma Al Riyami** is the Dean of Sur College of Applied Sciences. He hold a PhD Degree on Philosophy of Education- Social Sciences' Curricula from College of Education at Yarmouk University. He supervised many Master theses in College of Education - Sultan Qaboos University and Sohar College, and Participated in many international conferences in the sultanate, Saudi Arabia, Lebanon and Qatar.



He Wrote eight books in Arabic, which are: Preparing Teacher Education in the Sultanate of Oman, Cultural Security, Globalization challenges and Education System, Examination Culture, Education and Awareness Development (Touristic- Political-Vocational), Traditional Omani Stories, Tourism Education in Oman, Blood and Tears and Human Straggle for Liberty and Fairness and Democracy.

He wrote many papers in political awareness, touristic awareness environmental awareness, historical research skills, globalization and cultural identity, examination culture, teacher preparing program, cognitive development programs and using technology in teaching.

He won the Best Research Award in the sixth forum of Oman Studies Unit under the tittle Al Aotabi Al Sahari International symposium.

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**Dr. Suhaila M. Abbas** is Associate Professor at Mazoon University College. She has about 30 years of experience in Business Administration Teaching at graduate and post graduate levels. She supervised many PhD and Master Dissertations. She has taught a variety of courses, including HR, Strategic Management, Research Methods, Organizational Behavior and Business Ethics. Dr. Suhaila has published (5) core books in Human Resources Management, Organizational Behavior, Career Development, Leadership and Creativity. Many research papers and articles were published by Dr. Suhaila during her career life. Recently she is teaching MBA students at Mazoon University College .

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**Dr. Mathew Philip** is the Vice Dean for Academic Affairs and Associate Professor at Muscat College. He has about 22 years of experience in management education, training and consulting and holds Master and PhD degrees in Business Administration. He has taught a variety of courses, including Marketing, Business Strategies, Research Methods, Organizational Behaviour and supervised a number of Dissertations. His research interests are diverse, touching several areas of management, and involving developments of business models in real life situations. Dr. Mathew has to his credit many research papers and articles. He has conducted various corporate training programmes in leadership and managerial skills, marketing and supply chain, people management and selling. In addition to the above he has experience in holding key administrative roles in Higher Education Institutions, such as Head of MBA programme, Chair of Committees and Programme Manager for the University of Stirling at Muscat College.



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**Dr. Jabbar Bin Jabbar Bin Rahman Al Saadi**, is working as Associate Professor of Theoretical Physics, Rustaq College of Applied Science. He got his Ph.D. in Theoretical Physics, from Manchester University in 1985. He got his M.Sc. in Theoretical Strucre Nuclear Physics from Manchester University in 1982.



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## ROADMAP FOR RECOVERY AMID CHALLENGES FACING OMAN TOURISM

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**Dr. Sedat Yuksel**

*(College of Applied Sciences, Sohar)*

### ABSTRACT

In this study, it is aimed to describe and analysis challenges of Oman tourism and to explain how Omani Government overcomes challenges facing Oman tourism in view of World Tourism Organization Roadmap for Recovery which is aimed to promote the roadmap to key decision makers at national, regional and global levels. As the method of study, global and technical perspective of the Roadmap has been adopted to Omani context within practicable viewpoint for decision makers via gathering secondary and qualitative data from local sources. Tourism should be integrated into national, regional and international legislation/regulations that encompass and encourage green economy, employment and investment strategies. Rather than specific subsidization policies for tourism industry, Omani Government should impulse and encourages sustainable production which is direct or indirect related to tourism.

***Keywords:*** Recovery, Crises, sustainable, Oman, UNWTO

## INTRODUCTION

Tourism & Travel (*hereafter tourism*) refers to a wide range of domestic and international tourism business and activities which incorporate transportation, accommodation and related services. Tourism both for business and leisure purposes has become an integral part of consumer's lifestyle and companies' operations in today's globalized world.

As a primary vehicle for job creation and economic recovery, tourism provides more than 75 million direct jobs worldwide and offers fast entry into the workforce, particularly for youth and women in urban and rural communities. Tourism contributes directly and through its multiplier effect to global job creation and economic recovery. As a lead export sector, tourism has 30% of the world's exports of services (1 trillion US\$ a year) and up to 45% of the total export of services in developing countries. Tourism is well-positioned and committed to progressively reducing its carbon emissions and contributing to the transformation towards a Green Economy (UNWTO, 2009a).

Over the last few decades, tourism industry has experienced various setbacks, faced severe natural and man-made crises and through it all, has demonstrated a remarkable resilience, coming out stronger and healthier than before. International tourist arrivals showed an average annual growth of 4.3% between 1995 and 2008, compared with the projected 4.1% (UNWTO, 2002).

The economic conditions, combined with the additional uncertainties brought about by the influenza A (H1N1) outbreak 2008 April, influenced on tourism demand – at least in the short term (UNWTO 2009a). International tourist arrivals worldwide declined by 7% between January and August 2009. Destinations worldwide recorded a total of 600 million arrivals, down from 643 million in the same period of 2008. Nevertheless, the downward trend that started in September 2008 may have begun to bottom out. Arrivals in the two high-season months of July and August declined by 3% compared with a decrease of 8% in the first half of the year, and data available for September points to a continuation of this upward trend (UNWTO, 2009b).

World Tourism Organization (*hereafter UNWTO*) launched the Roadmap for Recovery which is aimed to promote the roadmap to key decision makers at national, regional and global levels on 5-8 October 2009.

Although the tourism industry in Oman is comparatively new and a relatively small part of the total economy, it has been growing quite rapidly. As in previous crises, tourism earnings are expected to suffer more than arrivals as consumers tend

to trade down, stay closer to home and for shorter periods of time (UNWTO, 2009a). Consistently, Tourism industry in Oman which welcomed majority of arrivals from Gulf countries is being less impacted by global recession less than other destinations.

In the first quarter of 2009 the number of arrivals staying in four and five star hotels rose to around 218,000 –a 12.4% increase compared with some 194,000 over the same period of the previous year. In 2008, around 679,000 arrivals stayed in higher class hotels (MoT, 2010). Nevertheless, all the global challenges threatening tourism movements around the world affect on Oman tourism industry in the long range.

Especially in the first half of 2009, arrivals have been recorded a down turn -8% for the Middle East destinations (UNWTO, 2009b). In view of the dependency of Dubai, Muscat faces a decline in visitation over the course of 2009 and into 2010 as a result of the expected significant slowdown in international travel (Choufany, 2009).

In this study, it is aimed to describe and analysis challenges of Oman tourism and to find out how the Roadmap of UNWTO overcomes challenges facing Oman tourism.

## **1. TOURISM IN OMAN**

### **1.1. An Overview**

The government of Oman defined its` tourism policy as *`Promotion of a market climate leading to the maximization of the contribution of the tourism sector to the country's GDP and its socio-economic development`* and published a policy document entitled "Vision 2020". Omani Government has the intention to achieve an annual GDP growth of 7.4% (MoT 2010). According to the latest figures, in 2008 tourism accounted for just less than 4% of Oman's GDP (MarketResearch.com, 2009).

The Gulf Cooperation Council is Oman's largest tourism market and has seen significant growth in visitor arrivals by both air and road in recent years. The Ministry of Tourism will also specifically develop the Saudi Arabia market which is seen to have untapped potential. In May 2009, the Arab Tourism Ministers attended a meeting in Yemen, where they discussed plans of action for promoting tourism among Arab countries. It was mentioned that there was a need to promote inter-Arab tourism and achieve tourism integration as a step toward the economic integration of Arab states (UNWTO, 2009a). This action provides Oman to improve its` largest market.

Oman attracted 650,000 tourists in 2007, 12 percent more than the previous year. The goal, set in 2002, is to reach one million visitors in 2009. Omani Government

plans to target are wealthy niche tourists by focusing on cultural, environmental and adventure packages and intends to upgrade tourism infrastructure and increase its overseas advertising, with a particular focus on the EU, the US and Asia (MarketResearch.com, 2009).

The existing supply of hotel accommodation is the order of approximately 10,000 rooms in 2009, which is predominantly focused on Muscat, Dhofar, Al Batinah, and Al Sharqiya regions. On the basis that 23,000 rooms are constructed and using an assumed minimum occupancy rate of 60%, the targeted length of stay of 3.5 nights per the Tourism Marketing Strategy, the number of hotel visitors in 2015 is estimated to be approximately 2 million (MoT, 2010).

## 1.2. Challenges of Oman Tourism

Tourism, though resisting better than other sectors has not been immune to the deteriorating ecologic, economic and socio-political situations. In the global perspective, many global and long term challenges will have a significant, though still not totally clear, impact on consumers and markets. While considering bottlenecks of tourism in any country, global factors cannot be ruled out. Thus, it is better to classify challenges as external and internal. For the time being, many studies have been conducted on global challenges of tourism. The number of studies mentioned climate change and global warming (UNWTO, 2008) financial crisis, pandemic diseases (Ritchie et al, 2010; UNWTO, 2009a; 2009b; 2009c), terrorism (D'Amore, Anaza, 1986; Llorca-Vivero 2008) food and fuel crises (UNEP, 2008); as global challenge of tourism. Thus, in this study global challenges are mentioned without discussing. Because of the limits of the study, it is aimed to focus on internal bottlenecks specifically. Table 1 shows challenges of Oman Tourism.

**Table 1. Challenges of Oman Tourism**

External	Internal
● Climate change	● Lack of tourism information system
● Global warming	● Nature of the tourism product
● Catastrophes	● Seasonality effect and shorter LoS
● Financial Crisis	● Accommodation facilities
● Food Crisis	● Accessibility difficulties
● Fuel Crisis	● Higher leakage effect
● Pandemic diseases	● General:
● Political conflicts	High dependency on oil
● Global terrorism	Infrastructure

***Lack of tourism information system:***

Tourism statistics are being continually improved, and visitor surveys will start to assist with the more detailed understanding of the statistics in Oman. Nevertheless, it is difficult to say the industry was receiving accurate, actual and periodical information about all tourism dynamics. Tourism markets, touristic patterns, spending behaviors, trends cannot be analyzed or monitored without cumulative statistical input. Furthermore for forecasting tourism demand, past data is crucial. In recent case, at the secondary data obtaining stage of this study, the statistical data those inbounds, nationalities, total income, expenditures, length of stay etc. couldn't be obtained due to lack of statistics database.

On the other hand, the prevailing national accounting system considers accommodations and restaurants as the only tourist activities and does not count travel agents, tourist guides, rental cars, handicraft centers, and diving centers as tourist activities in Oman (MoT, 2010).

***Nature of the tourism product:***

Oman tourism product is based on warm climate for European tourists in winter and cool climate, -though only in Dhofar region - for Middle Eastern tourists in summer. Thus, Oman faces higher seasonality effect. Though yacht, heritage and adventure tourism have also portions in total tourism income, those are insignificant effects. Actually, those special interest tourism types are not well-organized and packaged as a package tour, but offered as a part of attractiveness of Oman for same tourist groups.

Besides of the nature of the tourism product, lower scale accommodation facilities are not able to satisfy longer staying demands for resorts in Oman. Unfortunately current LoS (length of stay) statistics are not accessible. According to tourism marketing strategy, the targeted length of stay is 3.5. Longer periods generate more income for destinations.

***Accommodation Facilities:***

In Oman, hotel markets still operate under an owners' cartel agreement (Choufany, 2009). The Muscat area is the main centre for tourism development and many of the new schemes are in the Muscat region. Currently there are approximately 6,000 hotel rooms and projected growth to 20,000 rooms by 2015 (Deloitte and Touche, 2008). Table 2 shows performance of higher luxury class (four, five stars) those 60% of Muscat and 45% of Oman hotels in total.

**Table 2 Performance of Higher Class Hotels in Muscat**

Year	Average Annual Occupancy (%)	Average Rate (USD)	RevPar Performance (revenue per available room)
1994	67	103	69
1995	66	103	68
1996	64	112	71
1997	71	101	72
1998	56	95	53
1999	57	91	52
2000	55	86	47
2001	62	80	50
2002	59	74	44
2003	57	66	38
2004	69	82	57
2005	80	117	94
2006	74	154	114
2007	67	283	190
2008	69	329	227
Com. Annual Growth Rate for Muscat	Average 65	9%	9%
Com. Annual Growth Rate for ME	Average 67	5%	6%

Adapted from Choufany, 2009.

Muscat higher class hotels offered the second most expensive accommodation services in top 16 destinations of Middle East for past three years. In 2008, whilst the average rate for Middle East region was US\$197, it was US\$329 for Muscat. Consistently, RevPAR (Revenue per available room) performance (2008) of Muscat luxury hotels was US\$227 (the third highest rate) while the average for region was US\$146 (Choufany, 2009).

In Oman, following bottlenecks can be mentioned about hospitality sector.

- Shortage in small and medium sized hotel supply (Deloitte and Touche, 2008).
- Relatively higher prices.
- Relatively lower quality of service in hospitality
  - ▶ Lack of qualified staff for hospitality services
  - ▶ Lack of multi optional culinary services
  - ▶ Cleanness, hygiene and sanitation standards in lower class hotels

### ***Accessibility Difficulties:***

Accessibility is one of the three dimensions of tourism product in any country. Domestic transportation facilities should be enriched with other transportation modes as well as international. For example, sea transportation is a crucial, eco friendly and cost effective transportation mode, besides its` uniqueness, and attractiveness as a tourist product.

### ***Higher Leakage Effect:***

In economic terms, leakage could be defined as losses from the national income flow. Oman has import-weighted economy for inputs of tourism operations. Furthermore expatriates employed in tourism sector are also major group in the total tourism staff. Import expenditures are flowing out from the local/national economy. They are observed to be the most important and significant leakage item, since import is a product of the expenditures that goes out from a local/national economy (Lundberg et al.,1991). Some other leakage items (Hudman and Hawkins, 1989) that Omani Government should take account of are:

- ▶ Payments for foreign tour operators and agencies
- ▶ Payments to foreigners for management contracts and royalties, know-how transferring, patents,
- ▶ Profits, that are paid to foreign stakeholders
- ▶ Interest paid for external credits in the tourism sector
- ▶ Exchange costs for tourism investments

### ***General Internal Challenges:***

- ▶ *Lack of Infrastructure*, The Government of Oman give priority to develop general infrastructure circumstances in countrywide operations. Not only in the touristic centres but also all regions in Oman, main infrastructure facilities should be improved.

- ▶ *Highest dependency on oil consumption.* As the rest of the world, Oman has to improve renewable energy sources and utilization as soon as possible. The oil and natural gas are the main export products; this mandatory is not only for eco-friendly policies, but also to save Oman oil reserves to get national competitive advantages for long term.

## **2. UNWTO ROADMAP FOR RECOVERY**

United Nations World Tourism Organization (UNWTO) kicked off the UNWTO Roadmap at ITB (International Tourism Boerse) Berlin on March 2009. It is expected that the Roadmap works closely with Member States to undertake a series of initiatives designed to help strengthen support for tourism as a key contributor to economic recovery, sustainable development, and job creation (UNWTO, 2009a).

UNWTO Roadmap for Recovery has been developed by Core Working Group of Tourism Resilience Committee, and was launched in the eighteenth Session of UNWTO General Assembly in Astana, Kazakhstan on 5-8 October 2009.

### **2.1. Necessities of The Recovery Plan**

When the UNWTO kicked off a recovery plan, the world economy faced an unprecedented crisis, triggering one of the most severe recessions in generations. The world's GDP was forecasted to decline by some 1.4% in 2009 (IMF, 2009), the exports have been dramatically reduced and all advanced economies were in recession. Even the emerging economies, which at the beginning seemed to resist better, were rapidly facing the impact of the economic crisis. Global unemployment increased by an additional 29 million to 59 million unemployed people in 2009 (ILO, 2009).

UNWTO Secretary-General expressed the necessity of roadmap that 'throughout this year, the world's tourism industry was faced with a large number of challenges, led by the global economic crisis, the credit crunch and rising unemployment, not to mention the influenza pandemic. Seldom in recorded tourism history has the industry had to contend with so many different issues at the same time,' (UNWTO, 2009b).

Tourism, though resisting better than other sectors has not been immune to the deteriorating economic situation. After a very sound start, with worldwide growth in international arrivals averaging nearly 6% in the first six months of 2008, demand fell harshly – by 1% between July and December 2008. As expected, this trend has intensified in 2009- international tourist arrivals fell by an estimated 8/9% during the first six months of 2009 (UNWTO, 2009c).

As experienced in previous crises, tourism earnings have suffered somewhat

more than arrivals. Receipts from international tourism were estimated to have contracted in real terms by 9% to 10% in the first six months of 2009, i.e. 1 to 2 percentage points below the decline in international arrivals during that period (-8%) Given the high level of correlation between arrivals' and receipts' growth, for the whole of 2009 receipts were expected to decrease by 6 to 8% (UNWTO, 2009b).

All around the globe, companies, and particularly small and medium enterprises (SMEs), which make up the bulk of the tourism sector, faced increasing difficulties as demand declined and access to credit became harder (UNWTO, 2009a).

## **2.2. An Overview of the Roadmap**

The Roadmap includes a set of 15 recommendations based on three interlocking areas: Resilience- Stimulus – Green Economy.

UNWTO established a Tourism Resilience Committee (TRC) to provide a framework for better market analysis, collaboration on best practices and policymaking (UNWTO, 2009c). Those can be seen below what TRC advises to support the sector's immediate response (UNWTO, 2009a):

- a) Focus on job retention and sector support
- b) Understand the market and respond rapidly
- c) Boost partnerships and 'cooperation with competition'
- d) Advance innovation and technology
- e) Strengthen regional and interregional support

UNWTO stressed that spending on tourism can pay massive returns across entire economies due to the contribution of the sector to exports and employment (UNWTO, 2009c). Following are targeted by stimulus (UNWTO, 2009a):

- a) Create new jobs – particularly in SME's
- b) Mainstream tourism in stimulus and infrastructure programs
- c) Review tax and visa barriers to growth
- d) Improve tourism promotion and capitalize on major events
- e) Include tourism in aid for trade and development support

Tourism must be at the forefront of the transformation to the green economy contributing with carbon-clean operations, jobs in environment management and energy-efficient building (UNWTO, 2009c). Purposively actions are (UNWTO, 2009a):

- a) Develop green jobs and skills training

- b) Respond effectively to climate change
- c) Profile tourism in all green economy strategies
- d) Encourage green tourism infrastructure investment
- e) Promote a green tourism culture in suppliers, consumers and communities

### **3. THE ROADMAP FOR OMANI TOURISM**

Challenges/bottlenecks facing Oman tourism either internal or external are not unsolvable. Nevertheless, action plans should be projected for long term. We grouped actions in the nine subtitles below in light of Roadmap for Recovery by UNWTO.

#### **3.1. Setting Tourism Information and Forecasting Support Systems**

Actions implemented for setting tourism information and forecasting support systems in Oman are mentioned below:

- Redefine national accounting system;
- Analysis of needs for tourism data;
- Increasing collaboration, research and information exchange between public and private sectors, international organizations and educational institutions as well as the development of new tools and data analysis.
- Close monitoring and analysis of changing trends and early reaction;
- Building networks for tourism knowledge at national, regional and international level;
- Enhancing cooperation with the UNWTO and other organizations for network links and support systems (UNWTO, 2009a).

#### **3.2. Improving Tourism Product**

Oman can improve her tourism product by monitoring trends in tourism. There are many special interest tourism types considerable for improving tourism product. However, it is a generally accepted opinion that eco friendly, well-preserved, green-blue combined tourism products are always favored by worldwide tourism markets. Green-blue combined tourism product also extends the length of stay and increases tourism income indirectly. Mechanisms should be funded for the development of 'green' tourism products and services such as hiking, cycling, ecotourism, and rural tourism.

A major focus for tourism development over the forthcoming years is for Oman

is to develop a whole range of tourism products that will widen its perceived tourism product portfolio. Examples of new products will include (Deloitte and Touche 2008):

- Round the country Tours
- Yachting Ports, Marinas, Shelter Harbors
- Eco-tourism
- Health and Spas Tourism
- Adventure Tourism
- Diving
- Cultural tourism
- Event tourism
- Cruise shipping
- MICE (Meeting, Incentive, Conference, Exhibition) tourism

### **3.3. Developing Tourism Markets**

New markets are preferable for touristic destinations. Nevertheless, it is not easy to attract to destination new tourists. Creating new markets depends on market research and analysis efforts. According to Roadmap for Recovery, besides creating new tourism markets, current markets should also be strengthened via following actions:

- Reductions on travel taxes.
- Exemption from visa fees,
- Elimination/simplification of visa requirements and electronic visas could be considered wherever feasible.
- Intraregional collaboration on travel facilitation.
- Visa elimination, transport liberalization, tax moderation (UNWTO, 2009a).
- Development and promotion of multi-destination itineraries;
- Organization of cross-boarder events and festivals;
- Creation of platforms to exchange know-how and share information on source markets (UNWTO, 2009c).

### **3.4 Managing Technology and Innovation**

Effectively using and managing technology is a part of sustainability. The following actions are recommended for maximizing effectiveness in technology management:

- Review border systems, e-visas, air and ground traffic handling,
- Congestion management.
- Waste reduction
- Energy-efficient technologies.
- Providing financial support and capacity building for developing countries and Small and Medium Enterprises (UNWTO, 2009a).

### **3.5. Creating New Employment and Improving Hospitality Services**

Oman should increase aggregate supply of small and medium sized hospitality businesses. For creating new employment and strengthening human resources, small and medium sized hospitality businesses can play a frontier role in Oman. To achieve those objectives, the following actions should focus on SMEs:

- To recognize the special needs.
- Providing credit lines (including micro credit).
- Special finance plans like tax reduction, export promotion, job support or retraining.
- skills training, either by sector specific mechanisms or by specific educational programs and vocational training for the tourism industry,
- Green products/services and quality support activities.
- To undertake actions to retain the core workforce and maintain training standards.
- Identify green programs and new associated jobs, as well as to provide the appropriate training.
- Vocational training and alignment with overall tourism green training programs (UNWTO, 2009a).
- To consider going forward with annual quotas for releasing hotel licenses, specifically in terms of region and star grading.
- To request that license applications have a minimum amount of information on

the application, this should include a pre-feasibility study by the developer.

- To focus on branding as a way to regularize standards, especially in the lower star categories (Deloitte and Touche, 2008).
- To encourage venture capital system for real estate investments projects that will affect mainly the accommodation and restaurant sector (UNWTO, 2009c).

### **3.6. Impulsion Green Economy**

According to the UNDP ‘Global Green New Deal’2 report, environmental policy actions and investments on ‘green sectors’ address not only the environmental crisis but also most importantly will provide high economic return (Barbier, 2009).

Exponential, limitless economic growth continues, so environmental depletion, degradation, and pollution has now exceeded the planet’s carrying capacity. There needs to be a focus on what called “Green GDP” – taking account of environmental degradation and resource depletion. This is particularly important in developing countries like Oman that may, for example, by building up residential or touristic complexes on the beaches or green areas. There are ways that those can be adjusted to avoid depletion of natural resources and degradation of the environment (Stiglitz, 2009). This is despite new environmental accounting methodologies and the application of ethics in modern academic economics (Stern, 2006; Stiglitz, 2002).

For the time being, Oman has focused on more immediate monetary, fiscal or marketing measures as part of its’ national stimulus packages. However, medium and long term plans require for the transformation to a green travel industry. In light of Roadmap for Recovery, particular consideration should be given to how this goal can be extended to tourism through affordable and viable actions like:

- To increase public awareness on sustainable tourism and stimulate the transformation towards the production and consumption patterns of a Green Economy.
- Adjustments in public expectations and a widespread industry participation in credible environmental certification programs are both necessary.
- Built internal and external messaging that tourism is a beacon for that change through its intensive communications activities.
- Incentives for adaptation, substantial financial support and low cost technology transfer for the all sectors.
- Confront commitments agreed by parties to respond to climate change.
- Associated financing for driving sectoral low carbon transport and accommoda-

tion, as well as the use of green technology.

- Integrated into national, regional and international regulations that encompass and encourage green economy strategies.
- Profiled high in green employment strategies. Green investment, planning, procurement, fuel efficiency, renewable energy programs must also cover tourism.
- Supporting the development of systems of low-carbon energy saving accommodation (UNWTO, 2009a).

### **3.7. Focusing on Infrastructure and Accessibility**

Investment in infrastructure has a direct effect on jobs in construction and related sectors. Furthermore, achievement in sustainable tourism planning and development is highly dependent on investment in infrastructure. Thus, the actions below are required:

- Funding eco-friendly tourism infrastructure and revitalizing transportation aimed at using renewable energies;
- Transport infrastructure -e.g. expressways, high speed trains, airports, ports and air traffic management systems;
- Apply climate proofing and sustainable design equally to hotels, attractions and other tourism facilities (UNWTO, 2009a).
- Financial benefits for air and sea transportation companies to operate routes to remote and underdeveloped areas and small islands (UNWTO, 2009c).

### **3.8. Strengthen Partnership with Stakeholders**

Public and private sector partnerships should be strengthened wherever possible to help preserve and create jobs, simplify procedures and regulations, and increase productivity. Tourism stakeholders should:

- Develop assistance for capacity building, technology transfer, green infrastructure/jobs (UNWTO, 2009a).
- Support for the expansion/maintenance of airline capacity;
- Organize co-promotional activities with airlines, hotels, travel agents
- Waive fees for the participation of travel professionals on tourism fairs abroad;
- Create market monitoring boards comprising representatives of government and stakeholders within the tourism value chain (UNWTO, 2009c).

### 3.9. Improving Marketing and Promotion Capabilities

According to UNWTO Recovery Roadmap, the actions below can be implemented to improve tourism marketing and promotion capabilities:

- Diversifying tourism strategies to avoid dependence on any one activity or market.
- Foreign visitors must be considered as part of national export promotion action.
- Marketing programs should address underlying demand shifts for better value/deals as well as competitive realities.
- Embracing the shift in consumer preferences towards internet and multimedia delivery is fundamental.
- Partnerships and regional cooperation should be explored to enhance Tourism promotion.
- The benefits offered by the involvement in major events, especially sports, should be explored.
- Organizing and promoting zero energy events like cycling festivals and walking marathons.
- Increasing the awareness of tourism professionals and tourists on
- environmental issues, climate change and renewable energy by organizing training seminars, educational programs and using media and communications networks domestically and internationally (UNWTO, 2009a).
- Promotion of domestic destinations and the encouragement of local visitors;
- Promotion of value added or reduce price package in major source markets;
- Promotion of social tourism and group travelling for holidays inside the country or granting of incentives and special discounts for travelling in off-peak season in order to decrease seasonality (UNWTO, 2009c).

## CONCLUSION

It cannot be said that Oman is a leading tourism country in the Middle East. Tourism in Oman is comparatively new and a relatively small part of the total economy. But Omani Government gives tourism priority as an important and sustainable socio-economic sector of the Sultanate (MoT, 2010).

Thanks to the current tourist markets, Oman was impacted less by the global

financial crisis than most other destinations. Even though the majority of tourist arrivals are from other GCC countries, all the global challenges threatening tourism industry around the world, unavoidably affect on Oman tourism in the long term. It can be stated that, UNWTO Roadmap will not only benefit to be immune by global challenges, will also benefit to overcome internal bottlenecks of tourism in Oman.

Innovation can play a leading role in assisting tourism to adapt to new sustained economic conditions, and also to reinforce tourism resilience and economic importance through stronger investment in human resources, better market knowledge and in technology. Adopting innovative practices and increasing the uptake of technology by all stakeholders should be encouraged. Cooperation and synergy should be maximized between all national, regional and international stakeholders; Coopetition (cooperation in competition) can extend beyond traditional frameworks into economic, employment and development areas (UNWTO, 2009a).

Not only for Omani but also for all decision makers, allocation and optimization of the scarce physical, financial, informational and human resources is a vital matter in strategic planning to get national competitive advantage. Thus, avoiding restrict specific subsidization policies for any sector, may increase multiplier effect of per dollar spent in the country. Otherwise it causes waste of resources and time.

In Oman, tourism should be integrated into national, regional and international legislation/regulations that encompass and encourage green economy strategies. It should also be profiled high in green employment strategies. Green investment, planning, procurement, fuel efficiency and renewable energy programs must also cover tourism. Thus Oman has to rethink the existing growth models and embrace the principles of sustainable development and the transformation to the green economy.

Rather than supporting specifically bigger residential or accommodation complexes, giving SME tourism businesses priority is more suitable and sustainable for creating new jobs and spreading tourism events to the entire country. Oman should impulse and encourage following sectors which are direct or indirect related to tourism. Those are, sustainable infrastructure, organic and sustainable agricultural production, food – nutrition industries, afforestation/forestry, stockbreeding, fishing, eco-friendly transportation modes (sea and rail transportation) renewable energies (solar, wind) and healthcare services.

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## **PROTECTION MODE FOR DATA TRANSMISSIONS BETWEEN MOBILE DATABASES**

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### **ABSTRACT**

Mobile computing and communication is a rapidly developing area. But mobility is associated with the problems of security and privacy beyond those in open networks. A well-known threat is tracking user movements. New risks are caused by the mobility of users. This paper represents four mobile transaction management models and a comparison between them which shows that all of them work without security transmission between mobile host (MH) and base station (BS). Moreover, this paper proposed new mode to keep data transmission at protected level.

## 1. INTRODUCTION

In the recent years, several research articles were published regarding security databases. Among them were those by [Notargiacomo. L. 1994; Lubinski. A. 2000; Garuba. M. 2005; Abdul-Mehdi. Z and Hason. N. 2006; Forouzan. B. 2007]. The articles reveal that the mobile database security management is one of the current issues in distributed database that has yet to be solved. On this basis this study has been initiated.

Mobile computing area has gained many issues since traditional model of the data transaction in the fixed network has upgraded to the mobile data transaction in the wireless network. One of the complicated issues in the mobile computing is security transmission of the database.

The security issues of the mobile database cover data transaction security over the wireless network. In this modern, the mobile data transaction security issues are more dominating because of the existing data transaction protocols and models and their old techniques and mechanisms. Most of the mobile data transaction models and mechanisms, which are using disconnection technique and check-out technique, did not pay attention much on the data transmission security over the wireless network. Especially, end to end mobile transaction security, which is the security of the data transmission between mobile host(s) (MH) and base station (BS), is a pressing issue in the mobile data transmission security area.

As a result, four transaction management models for mobile databases have been proposed, each of which has attempted to overcome some issues pertaining to transaction processing in mobile environment. However, four of them sharing with same issue in security transmission between mobile host (MH) and base station (BS).

## 2. TRANSACTION MODELS

This section will compare and review four transaction management models including Kangaroo model, planned disconnection, two tier model and Multi checkout time stamp model. Each transaction model will be discussed for the basic structure and operation of the models, but at the same time main focus on all these models to find the drawbacks of each model in security during data transaction.

### 2.1 Kangaroo

The Kangaroo model [Dunham. M. H *et al*, 1997 (a), 1999 (b); Turker. C *et al*, 2003; Örenç. Z 2004], is one of the earliest mobile data transactions, is based on the three tier architecture which consists client tier, middle tier and server tier as shown

in Figure1. The kangaroo model uses an authentication system which resides on the middle tier and assures the authorized connection between client and server tier. The authentication is based on client's ID and password, which are used to identify authorized client to the server. If the client access to server is authorized by the middle tier, then the connection between client tier and server tier will be established, and data transaction is accepted over the established connection. Middle tier, is an agent between client tier and server tier, establishes the connection. Once connection is established, data will be transferred between client and server. In the data transaction between client tier (MH) and middle tier (MSS), it does not use any additional secure mechanism but the connection is based on IEEE 801.11x protocol which includes some encryption models to encrypt and decrypt data. However, the IEEE 801.11x protocol has still suffered from vulnerability inside itself since weakness of using encryption in the IEEE 801.11x protocol is revealed to the public. The data transaction between middle tier and server tier is transferred through the fixed network which uses traditional security mechanism to the data transfer. The traditional security mechanism in wired network is more reliable and more secure than the data transmission security over the wireless network.

The data transmission between client tier and middle tier is still vulnerably except using additional encryption or specific security mechanism to data transmission in this the model. The non usage of the additional secure mechanism in this model makes possible hole for the hackers and attackers who have authorized access or have threats to the data.

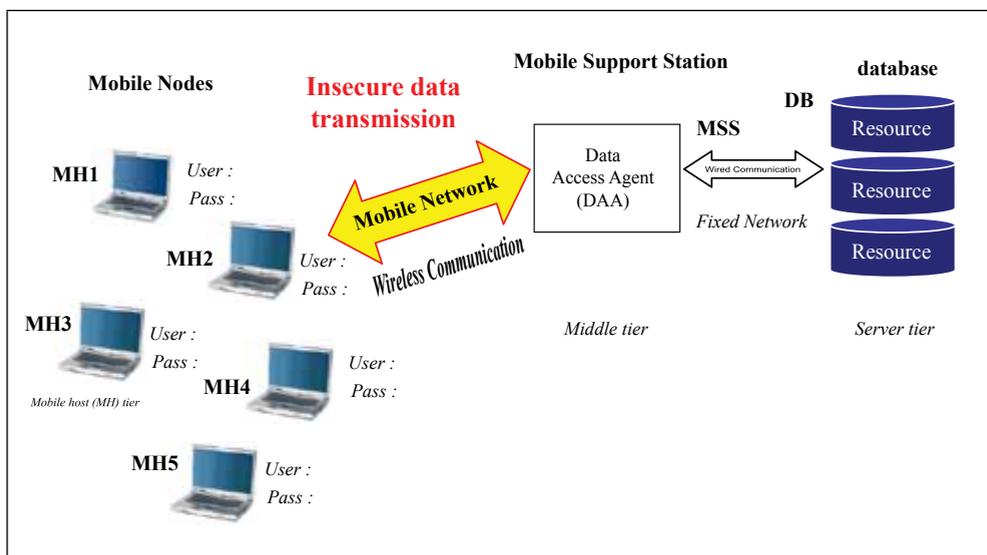


Figure 1 Kangaroo Model

The main vulnerability of this model is showed when the data transaction between Client tier and Middle Tier. Connection between client and server, is based on the IEEE 802.11x, is established by middle tier that assumes connection of the client as shown in figure above. If both the ID and password are correct, middle tier approves and the connection is established by IEEE 802.11x. During data transmission, the data is transferred through established connection which is based on the IEEE 801.x that includes encryption model with vulnerability. This data transmission between client tier and middle tier makes insecure condition in the kangaroo model due to fact that the IEEE 801.x. still has vulnerable for certain encryption.

## 2.2 Planned disconnection

The planned disconnection, is one of the mobile data transaction modes [Holliday.J *et al*, 2002], involves informing the distributed system of the intention to disconnect and may include the appointing of a proxy so that the remaining connected sites can continue processing with minimal disruption. In system model of the planned disconnection, the server allows the team members in a system to have normal processing on the data locally during disconnection and to send their updates on their data to the server lately. The planned disconnection has concentrated on the data processing as well. However, this model did not pay attention on the data transmission secure between client tier and server tier during the transaction. In this model, data transaction between the server and clients is transferred over the wireless network which is based on the IEEE 802.11x protocol. The IEEE 802.11x protocol includes cipher algorithms which is used to transfer data securely but some of using algorithms in the IEEE 802.11x has relived as vulnerable ciphers. Only secure mechanism in the planned disconnection works as authentication for the client access to the server. The authentication system assures that client make authorized access to the server but it is not works on the security of data and transmission.

Another of the faced issues in this model is security that concerns a mobile system where team members (mobile host (MH)s) disconnect and later reconnect as shown in Figure 2.

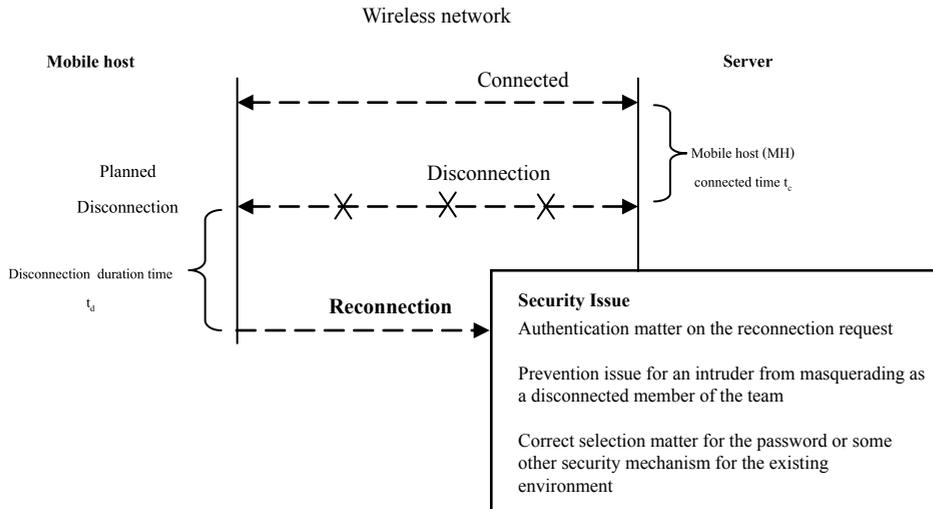


Figure 2 Planned disconnection

When client reconnects and wants the server back [Holliday. J *et al*, 2000], there are some issues such as authentication of reconnecting request, prevention for an intruder from masquerading as a disconnected member of the team, right selection problem for the password or some other security mechanism in this existing environment, and issue on the fit or not fit to allow for manual assignment of proxies for a team member that is known to have disconnected without signing off or who planned to be at a meeting and is unavoidably absent.

### 2.3 Two-tier

The two-tier replication model [Gray. J *et al*, 1996] is that client acts as one tier and application in combination with server acts as another tier as shown in Figure 3. In this model, the client and server are communicated directly to the each other by a wireless network. The client makes a data request to the server directly. The requesting data process at the server is replayed back and performed at the client. As the number of connections increases, the database performance degrades. Reason of the performance degrading is that each client connection requires CPU and memory inside the server. When large number of the clients request data frequently, this entails considerable administrative overhead. The figure below shows structure of the two tier data replication model. Classic example of the two-tier model is a SQL server and their web clients.

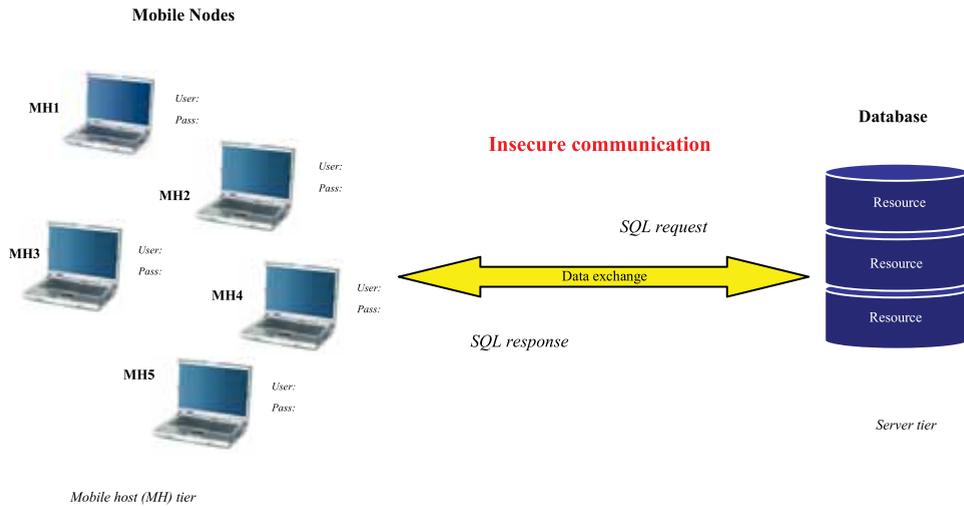


Figure 3 Two tier model

One of the vulnerable in the two-tier model is data transfer security. The model use client identification mechanism when the client is attended to the database. Even though the two-tier uses identification mechanism for the client, it does not apply security of the data transaction between server and clients. After the identification, during transaction, data between server and client is exchanged through the wireless network (IEEE 802.11x). The security mechanism in the two-tier model employs only on access of the client. The mechanism assures that client access is authorized and establishes a connection but after the identification, it does not work any more. The data transaction between client and the server is transferred through the IEEE 802.11x which assume encryption and decryption of the transferring data. However, the IEEE 802.11x is still vulnerable since disadvantages of the encryption in the IEEE 802.11x has emerged. This case makes fine opportunities to attackers, who wanted to do attack, damage and access to the database maliciously.

Another issue in the two-tier model is that the server might include simple constraints that disallow operations which would cause obvious data integrity problems. The data integrity, is one of the database security properties, refers to the validity of the data.

## 2.4 Multi Check-out Timestamp Order

The Multi Check-out Timestamp Order (MCTO) [Abdul-Mehdi. Z et al, 2006] is new data transaction technique and manages disconnection with data allocation for

the mobile nodes in a system. In system model in MCTO consists of the base station (BS) and several mobile host (MH(s)). The BS, which is connected with fixed network, stores the master data and allocates the part of the master data when the MH(s) connect and keep disconnect. When the MH(s) are connected, the BS allocates part of the master data with a time stamp, which is allowed time to the MH(s) to check out mode, and pass them to the MH (s). During the timestamp, the MH(s) are allowed to make change at their part of master data and pass it to the BS over the wireless network. The BS can receive their changes and update from the MH(s) before the timestamp is over. These sending and exchanging data transaction between the BS and MH(s) is transferred without change of the data structure.

The data transaction with unmodified data structure over the wireless network makes security vulnerability to the data security of the MCTO as shown in Figure 4 and 5 respectively.

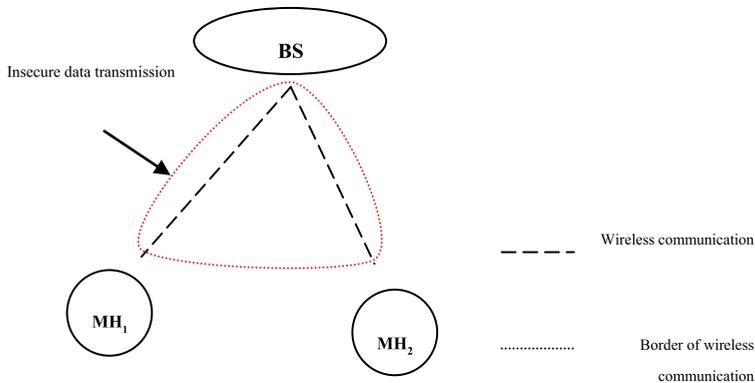


Figure 4 Insecurity data transaction in mobile network for MCTO model

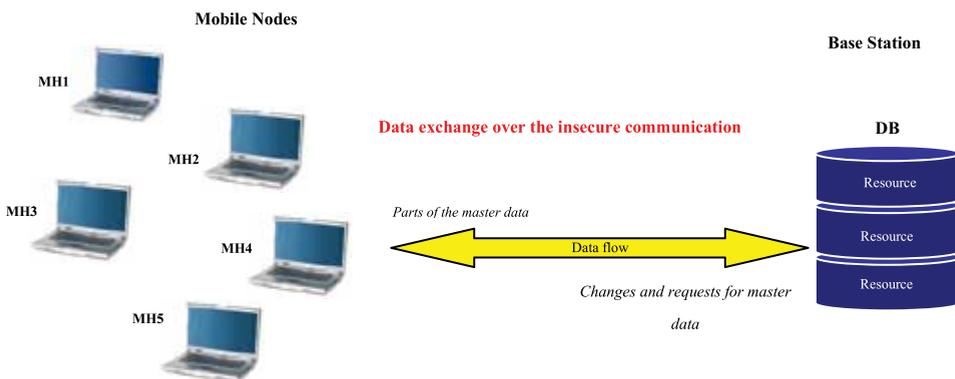


Figure 5 The Multi Check-out Timestamp Order (MCTO)

This insecure condition in the MCTO is caused by none of data transmission security mechanism usage in the MCTO. The MCTO uses a simple user authentication that confirms authorized access from the MH to the BS when the MH is connected to the BS but the authentication does not support for the data transmission security during the data transaction. The MCTO does not apply any security transmission mechanism for the data transaction between the BS and MH(s). The data is transferred without change through the insecure channel. Update and request data from MH(s) is also exchanged by wireless network (IEEE 802.11x), which has channel with vulnerable.

Four transaction models in mobile computing database are selected and explained with their problems. Each model includes a general figure and clearly discusses their current database security weakness. The weaknesses of the models are simply showed in the Table 1.

<b>Models</b>	<b>Usage of authentication</b>	<b>Additional secure mechanism for data transmission</b>	<b>Result</b>
<i>Planned Disconnection (2002)</i>	Yes but for client access to server only but there is no secure transmission between BS and MH	No but uses IEEE 802.11x	Still vulnerable
<i>Two tier (1996)</i>	Yes, it is used to identify users to connect to the server. It is not for secure data transmission purpose	No but uses IEEE 802.11x	Still vulnerable
<i>Kangaroo (2004)</i>	Yes but it is applied for client connection to the server only.	No but uses IEEE 802.11x	Still vulnerable
<i>MCTO (2006)</i>	Yes. The model uses user authentication that assures the client access to the server only but the model does not employ security to data transmission.	No but uses IEEE 802.11x	Still vulnerable

Table 1 Database security over the mobile transaction models

The above table presents list of data security drawbacks in each mobile data

transaction management models. The user authentications or identifications used in these models shows that just eliminating initial problem related to the security of mobile database, but their authentications do not work on database transmission security. The models only use IEEE 802.11x data transmission protocol that employs cipher algorithm to encrypt and decrypt databases. However, those models above are still showed in vulnerable condition due to fact that drawbacks of the encryption algorithms in IEEE 802.x is revealed. The models in the table 1 is observed as all of models are still in existed insecure condition, and needs additional security mechanism for the mobile data transaction over the insecure channel.

All of the discussed models here show the drawbacks in the security of data transmission, at the same time the importance of the additional security management during the data transmission to save the database from the external dangerous sources (i.e. hackers). Obviously the more security needs more time. So additional security mechanism for the data transactions needs or increases the transaction time. However, this additional time spent for security is going to keep the database at the consistency level. So, it's important to find a way to reduce the transaction time at the same time keeping the consistency of the data. So the main objective of the transaction management is to reduce time and the main objective of a good security is to take the time to ensure data security and database consistency level.

### **3. MOBILE DATA TRANSMISSION: A PROTECTION MODE**

The designed Mobile Data Transmission: A Protect Mode basically consisted of the data encryption and decryption models. Those two models are included in both the base station (BS) and mobile host (MH) applications. When data transaction is transmitted between the base station (BS) and mobile host (MH), the data encryption and decryption models are used to encrypt and decrypt the data transaction at mobile environment.

#### **3.1. Protection Mode**

The proposed designed protection mode is a cryptosystem that includes encryption and the decryption ciphers with authentication. It is very complex system which encrypts and decrypts data while it protects the data transaction from threats over insecure mobile network during the transaction process and controls the accessing mobile hosts (MHs) to request data from the base station (BS).

The encryption ciphers consist of the data encryption and the key encryption models, attached with the key agreement protocol. The data encryption which manages that ordinary data has to be encrypted as ciphered data before it can be trans-

ferred. The key encryption cipher however, ensures that the cipher key used in the data encryption must be encrypted to encrypted key before it can be sent. The authentication model verifies mobile host (MH)'s access and confirms the connection of the mobile host (MH) to the database server.

On the other hand, the decryption cipher consists of the data decryption and the key decryption models. Before all of the encryption and decryption started, the authentication of the mobile host (MH) establishes the connection between the base station (BS) and mobile host (MH) then the secret key exchange, data encryption and decryption are started. The data decryption model decrypts encrypted data, while the ciphered key is deciphered to ordinary key by the key decryption model.

The designed model serves the two applications that reside at the mobile host (MH) and base station (BS) respectively. The application at the base station (BS) protects the data transaction with encryption key and controls the access of the database from the mobile host (MH). The application at the mobile host (MH) is responsible to encrypt data and decrypt the encrypted data while it provides the mobile host (MH) authentication reply for every access.

## 3.2. Data and Key Encryption

### 3.2.1. The Data Encryption

The data encryption model, which is a symmetric cipher, includes data conversion, data extension and several rounds that contain a set of transformation functions. It typically converts blocks of the data (plain text) to the block of encrypted data (cipher text) by round keys that are generated from a key generator. The key encryption, is a hybrid cipher that comprise symmetric key cipher and asymmetric key exchange protocol, operates iterative rounds to encrypt the round keys by using the extended shared key. Figure 6 shows the breakdown processes involved in the encryption model.

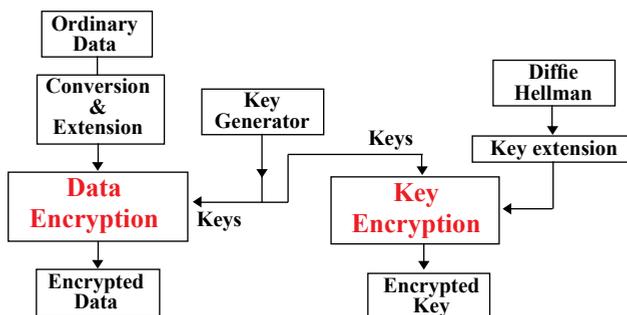


Figure 6 Breakdown process for the encryption models

In the conversion operation, the initial data value  $D$  which is in decimal is converted into binary value  $P$ , which holds 32 bits length. The conversion operation used in this mode is a common technique [12]; repeating division by 2. Table 2 illustrates an example of how the decimal number 53 is converted into binary representation.

Division	Quotient	Reminder	Binary
$53 \div 2$	26	1	1
$26 \div 2$	13	0	0
$13 \div 2$	6	1	1
$6 \div 2$	3	0	0
$3 \div 2$	1	1	1
$1 \div 2$	0	1	1

Table 2 Decimal to binary conversion

The converted data value in binary representation denotes as plaintext  $P^w$  which consists of 32 bits  $w\{x_{32}, x_{31}, \dots, x_1\}$  whereby  $w$  denotes the set of the  $x_i$  bits, expressed as the plain text. In the data encryption cipher,  $P^w$  passes through several operations before the encryption rounds operate. These operations, which are split, extension and expansion, are involved with a kind of the padding techniques and give more confusion and diffusion to the cryptanalysis. The split operation divides  $P^w\{x_{32}, x_{31}, \dots, x_1\}$  into four 8 bits as.  $P^w\{x_1, x_2, \dots, x_{32}\} \Rightarrow \{P_1^{w_1}, P_2^{w_2}, P_3^{w_3}, P_4^{w_4}\}$  The divided bits  $w\{x_i\}$  followed

$$w\{x_i\} \Rightarrow \{w_4 = \{x_{32}, x_{31}, \dots, x_{25}\}, w_3 = \{x_{24}, x_{23}, \dots, x_{17}\}, w_2 = \{x_{16}, x_{15}, \dots, x_9\}, w_1 = \{x_8, x_7, \dots, x_1\}\}$$

The next two operations are *extension and expansion*. The extension operation extends every bit  $x_i$  in the as  $P^{w_n}$  four times and separates it into 8 bits. In the result of the *extension* with split,  $Exp_j^{w_n}$  arrays with single row and 4 columns are produced, and associated operation of extension with split is as follows in expression (1).

$$(1) \quad P^{w_n} \Rightarrow Exp_j^{w_n} \left\{ Exp_j^{w_n} \left\{ x_{8n-2j}, x_{8n-2j}, x_{8n-2j}, x_{8n-2j}, x_{(8n-2j)-1}, x_{(8n-2j)-1}, x_{(8n-2j)-1}, x_{(8n-2j)-1} \right\} \right\}$$

where  $n \in \{4, 3, 2, 1\}$   $n$  - indicates number for array

$j \in \{0, 1, 2, 3\}$   $j$  -column number for array  $Exp_j^{w_n}$



plained plain text array  $ExpP_{i,j}^{w_p}$  passes through the initial round and 12 main rounds as encrypted data  $Exc_{i,j}^{w_p}$ .

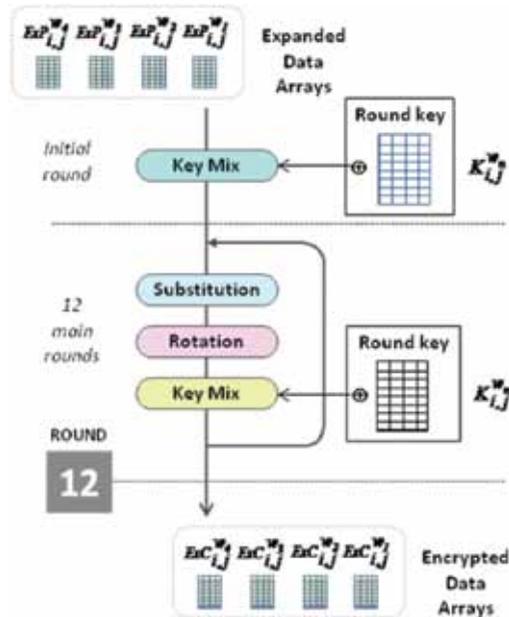


Figure 7 Data Encryption model

The **Key mix** operation combines the input bits of plain text  $ExpP_{i,j}^{w_p}$  and bits of generated key  $k_{i,j}^{(r_0)}$  by eXclusive-OR (XOR) operator. The round key is derived from a key generator to generate keys randomly. The operation is shown in expression (6).

$$(6) \quad a_{i,j}^{(r_1)} = ExpP_{i,j} \oplus k_{i,j}^{(r_0)}$$

The **Byte Substitution** operation supports the core of the security of the designed protection model. Basically, this operation is part of the substitution operation used in AES [5]. The operation substitutes each byte in the array based on the substitution table (S-box). The S-box is constructed from two transformations such as multiplicative inverse  $GF(2^8)$  and affine transformation. The functions of the transformations are expressed in expression (7) and (8).

$$(7) \quad \text{Multiplicative inverse} \quad \left( a_{i,j}^{(r)} \right)^{-1} = M.inv \left( a_{i,j}^{(r)} \right)$$

$$(8) \quad \text{Affine transformation} \quad M \cdot (Mult.inv) + v$$

At the multiplicative inverse operation (Mult.inv), the bits of input  $a_{i,j}^{(r)}$  are updated to the  $\left( a_{i,j}^{(r)} \right)^{-1}$  over the GF (2<sup>8</sup>) by using the lookup table for the multiplicative inverse operation. The look-up table is attached as reference in the appendix section. After the

multiplicative inverse, the affine transformation is applied (shown in expression 9).

$$(9) s_{i,j}^{(r)} = M \cdot (a_{i,j}^{(r)})^{-1} + v$$

At the affine transformation, output of the multiplicative inverse  $(a_{i,j}^{(r)})^{-1}$  is combined with matrix  $M$  and constant vector  $v$  by XOR operator. The output of the affine transformation is  $s_{i,j}^{(r)}$  result of the Byte Substitution. The affine transformation operation is depicted as in Figure 8.

$$s_{i,j}^{(r)} = \begin{bmatrix} 1 & 0 & 0 & 0 & 1 & 1 & 1 & 1 \\ 1 & 1 & 0 & 0 & 0 & 1 & 1 & 1 \\ 1 & 1 & 1 & 0 & 0 & 0 & 1 & 1 \\ 1 & 1 & 1 & 1 & 0 & 0 & 0 & 1 \\ 1 & 1 & 1 & 1 & 1 & 0 & 0 & 0 \\ 0 & 1 & 1 & 1 & 1 & 1 & 0 & 0 \\ 0 & 0 & 1 & 1 & 1 & 1 & 1 & 0 \\ 0 & 0 & 0 & 1 & 1 & 1 & 1 & 1 \end{bmatrix} \cdot \begin{bmatrix} x_0 \\ x_1 \\ x_2 \\ x_3 \\ x_4 \\ x_5 \\ x_6 \\ x_7 \end{bmatrix} + \begin{bmatrix} 1 \\ 1 \\ 0 \\ 0 \\ 0 \\ 1 \\ 1 \\ 0 \end{bmatrix}$$

Figure 8 Affine transformation. where xi denotes single bit of the input byte or output byte of the multiplicative inverse. Last byte 11000110 expresses constant vector v. matrix 8x8 used is as liner mapping.

The **Bit Rotation** is the next operation after the substitution. It rotates  $d_i$  input bits of  $s_{i,j}^{(r)}$  to the left side by 3 bits.

$$s_{i,j}^{(r)} \{d_0, d_1, d_2, d_3, d_4, d_5, d_6, d_7\} \textcircled{\text{R}} t_{i,j}^{(r)} \{d_3, d_4, d_5, d_6, d_7, d_0, d_1, d_2\}$$

where  $d_i$  - denotes single bits of  $s_{i,j}^{(r)}$  or  $t_{i,j}^{(r)}$

The rotation operation is expressed in expression (10).

$$(10) t_{i,j}^{(r)} = \text{BitRot}(s_{i,j}^{(r)}) = s_{i,j}^{(r)} * 8 - \left\lfloor \frac{s_{i,j}^{(r)}}{32} \right\rfloor * 255$$

The **Key mix** is the last operation in every round of data encryption model. This operation is similar with the initial round key mix, and it is a combination of the round key  $k_{i,j}^{(r)}$  and input data  $t_{i,j}^{(r)}$  by XOR operation as in expression (11).

$$(11) m_{i,j}^{(r)} = t_{i,j}^{(r)} \oplus k_{i,j}^{(r)}$$

where  $(r)$  - round number  $r \in \{1, 2, \dots, Nr\}$ ;

$Nr$  - Total number of round;

$k_{i,j}^{(r)}$  - Round key

If there are 12 rounds in the data encryption, the single round function is expressed by expression (12).

$$(12) Rn^{(r)} = \left( t_{i,j}^{(r)} \circ \left( M \cdot \left( a_{i,j}^{(r)} \right)^{-1} + v \right) \right) + k_{i,j}^{(r)}$$

A whole data encryption function with 12 rounds is as in depicted in expression (13).

$$(13) En(ExC_{i,j}^{W_n}) = Rn^{r12} \circ Rn^{r11} \circ \dots \circ Rn^{r3} \circ Rn^{r2} \circ Rn^{r1} \circ \left( ExP_{i,j}^{W_n} \oplus k_{i,j}^{(0)} \right)$$

$En()$  - Encryption function

$ExC_{i,j}$  - Cipher text for expanded data

After the conversion, the initial plain text which is in 32 bits are extended and encrypted by expression (11) to produce as cipher text  $ExC_{i,j}$  in 128 bytes when the data encryption process is over. The round keys are also generated randomly from a key generator to every key mix operation during the encryption process.

### 3.2.2. The Key Encryption Model

Figure 9 depicts the operations in the key encryption model. Basically, the key encryption model consists of 12 rounds that include the rotation and key mix operations. The rotation and key mix operations used in the key encryption are same with previous rotation and key mix operation in the data encryption model.

The functions of the rotation and key mix operations follows respectively as expression 14 and 15.

$$(14) t_{i,j}^{(r)} = BitRot\left(t_{i,j}^{(r)}\right) = s_{i,j}^w * 8 - \left\lfloor \frac{k_{i,j}^w}{32} \right\rfloor * 255$$

$$(15) m_{i,j}^{(r)} = t_{i,j}^{(r)} \oplus Ext\_sk_{i,j}$$

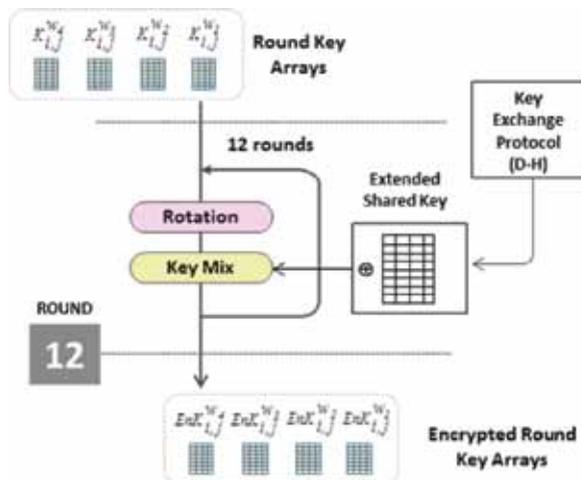


Figure 9 Key encryption model

Those operations iteratively encrypt the round keys used in data encryption by using an extended shared secret key. The shared secret key is exchanged between connecting two parties (base station (BS) and mobile host (MH)) and established from use of the D-H protocol. Once exchanged shared/secret key  $sk$  is extended then extended shared/secret key  $Ext\_sk$  is applied to key mix operation in every round.

The round keys in the key encryption model are the keys that are extended from shared secret key of the key exchange protocol. The key extending method is same way with extension used in the data encryption. The technique for shared key establishment used is D-H protocol [8], [18] that is used to securely establish shared secret key between the base station (BS) and mobile host (MH) without prior knowledge each other. D-H is asymmetric key cryptography. It is also known as key agreement, key establishment and key negotiation. The D-H without authentication is vulnerable to man-in-the-middle attack [8]. Thus, the D-H used in our secure design is equipped with the authentication model. The authentication is discussed in Section 4.

### 3.3. Data and Key Decryption Models

Figure 10 depicts the decryption model which consists of the authentication, data decryption and key decryption models that produce the plain text  $P$  and ordinary round key  $K_{i,j}$  from a given cipher text  $ExC_{i,j}$  and encrypted round key  $EnK_{i,j}$ . The authentication part provides the connection confirmation of the mobile host (MH) to base station (BS) and initials shared key exchange and decryption processes. The data decryption model is used to convert cipher text to plain text by using the cipher key. The key decryption model transforms the encrypted key to ordinary key by using extended shared secret key. Figure 10 presents the decryption models without authentication model. The authentication is discussed in Section 4.

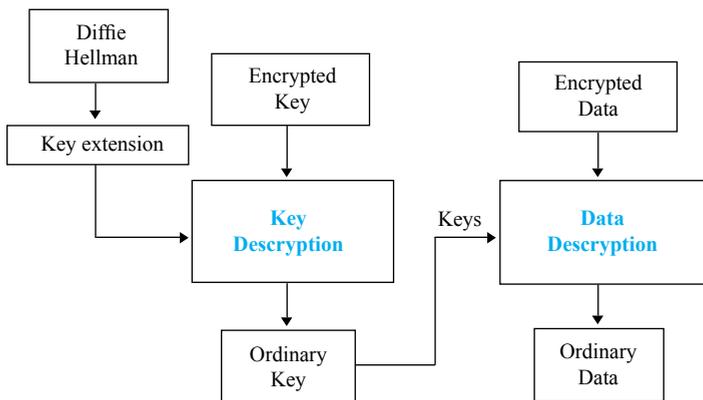


Figure 10 Breakdown processes for the decryption models

### 3.3.1. The Data Decryption Model

In the data decryption model, the first 12 rounds contain the inverse key mix, inverse bit rotation and inverse substitution operations. However, in the last round, it contains only a mix key operation is involved as illustrated in Figure 11.

The **Inverse key mix** (expression (16)) is a combination of the encrypted data  $ExC_{i,j}^{(r)}$  and round key  $k_{i,j}^{(r)}$  by XOR operation.

$$(16) \text{ inv\_}b_{i,j}^r = ExC_{i,j}^{(r)} \oplus k_{i,j}^{(r)}$$

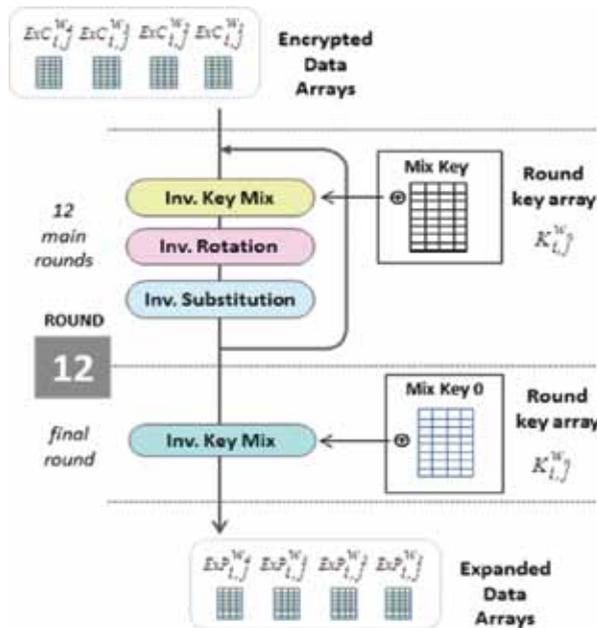


Figure 11 Data decryption model

The **Inverse bit rotation** operation rotates the input data  $b_{i,j}^r$  to the right by 3 bits. The inverse rotation is expressed in expression (17).

$$(17) \text{ Inv\_BitRot}(t_{i,j}^{(r)}) = b_{i,j}^r * 32 - \left\lfloor \frac{b_{i,j}^r}{8} \right\rfloor * 255$$

The **Inverse substitution** substitutes the value of the encrypted data to become an ordinary value of the data based on the inverse substitution table (Inv. S-box). The Inv. S-box consists of the inverse multiplicative inverse and inverse affine transformation as expressed in expressions (18) and (19).

$$(18) \text{ Inverse Multiplicative inverse } a_{i,j}^{(r)} = f(M.\text{inv}(t_{i,j}^{(r)}))^{-1}$$

$$(19) \text{ Inverse Affine transformation } (M^{-1}(a_{i,j}^{(r)} + v))^{-1}$$

For a single function, the inverse substitution is expressed as in equation

$$(20) \text{ Subs}(c) = \left( M^{-1} \left( r_{i,j}^{(r)} + v \right) \right)^{-1}$$

The matrix representation view of the inverse substitution operation is expressed in expression (21):

$$(21) \begin{matrix} \begin{matrix} s_0 \\ s_1 \\ s_2 \\ s_3 \\ s_4 \\ s_5 \\ s_6 \\ s_7 \end{matrix} \\ s_{i,j}^{(r)} \end{matrix} = \begin{pmatrix} 1 & 1 & 1 & 1 & 0 & 0 & 0 & 1 \\ 1 & 1 & 1 & 1 & 1 & 0 & 0 & 0 \\ 0 & 1 & 1 & 1 & 1 & 1 & 0 & 0 \\ 0 & 0 & 1 & 1 & 1 & 1 & 1 & 0 \\ 0 & 0 & 0 & 1 & 1 & 1 & 1 & 1 \\ 1 & 0 & 0 & 0 & 1 & 1 & 1 & 1 \\ 1 & 1 & 0 & 0 & 0 & 1 & 1 & 1 \\ 1 & 1 & 1 & 0 & 0 & 0 & 1 & 1 \end{pmatrix} \cdot r_{i,j}^{(r)} \oplus \begin{pmatrix} d_0 \\ d_1 \\ d_2 \\ d_3 \\ d_4 \\ d_5 \\ d_6 \\ d_7 \end{pmatrix} \oplus \begin{pmatrix} 1 \\ 1 \\ 0 \\ 0 \\ 0 \\ 1 \\ 1 \\ 0 \end{pmatrix}$$

where  $s_{i,j} \{s_0, s_1, s_2, s_3, s_4, s_5, s_6, s_7\} \rightarrow s_n$  denotes  $n$ -th bit in  $s_{i,j}$  byte

In the last round of data decryption, the inverse key mix operation is operated singularly, and this operation is same as the inv. key mix operation in the previous rounds. By inv. key mix, input data  $s_{i,j}^{(r)}$  is combined with the round key  $k_{i,j}^{(r)}$  by XOR operation. The inverse key mix operation is as shown in expression (22).

$$(22) \text{ inv\_} b_{i,j}^r = s_{i,j}^{(r)} \oplus k_{i,j}^{(r)}$$

For a single round, an expression is denoted by expression (23).

$$(23) DRn^{(r_n)} = M^{-1} \cdot \left( \left( r_{i,j}^{(r_n)} \circ \left( \text{Exp}C_{i,j}^{(r_n)} + k_{i,j}^{(r_n)} \right) \right) + v \right)^{-1}$$

Expression (24) expresses the complete round function of the data decryption.

$$(24) D(P^w) = \left( DRn^{r_{12}} \circ DRn^{r_{11}} \circ \dots \circ DRn^{r_3} \circ DRn^{r_2} \circ DRn^{r_1} \right) \circ \text{Exp}P_{i,j} \oplus k_{i,j}^{(0)}$$

After expression (24) is applied, the expanded data array is reduced and merged into integrated single binary in 32 bits. The integrated binary is then converted to decimal as ordinary data. Once the encrypted data is decrypted as ordinary data, the data can be updated and transacted as ordinary data.

At the reduction operation level, the expanded data array is reduced to array with single row as expressed in expression (25).

$$(25) \text{ Exp}P_j^{w_n} = \left\{ \text{Exp}P_{i,j}^{w_n} \wedge \text{Exp}P_{i+1,j}^{w_n} \wedge \text{Exp}P_{m,j}^{w_n} \wedge \text{Exp}P_{m+1,j}^{w_n} \right\}$$

where  $\wedge$  denotes AND operation;

$w_n$  indicates a number of the bits;

$n \in \{1, 2, \dots, 4\}$

$i \in \{1, 3\}$

$$j \in \{1, 2, \dots, 4\}$$

$$m \in \{5, 7\}$$

After the reduction operation, every column in the single row array  $Exp_j^{w_n}$  is combined as a binary  $Exp^{w_n}$  in 32 bits. As the result, there is 4 different 8 bits  $P^{w_n} \{P^{w_1}, P^{w_2}, P^{w_3}, P^{w_4}\}$   $n \in \{1, 2, \dots, 4\}$ .

In the integration operation, the separated plain text  $P^{w_n}$  is integrated into single binary  $P$  and converted to the decimal  $D$  (as initial data item) before the data encryption take place.

The conversion technique [13] from binary to decimal is as follows:

$$Conv(D) = P \{x_n * 2^{n-1} + \dots + x_8 * 2^7 + x_7 * 2^6 + x_6 * 2^5 + x_5 * 2^4 + x_4 * 2^3 + x_3 * 2^2 + x_2 * 2 + x_1 * 1\}$$

where  $x_n$  denotes n-th bit of the byte  $P$

Once data in binary is converted to the decimal representation, it could be used as the ordinary data.

### 3.3.2. The Key Decryption

The key decryption model is used to decrypt the encrypted round key produced from the key encryption model as round key to the data decryption model. The key decryption model consists of 12 rounds that have inverse key mix and inverse rotation operations as shown in Figure 12.

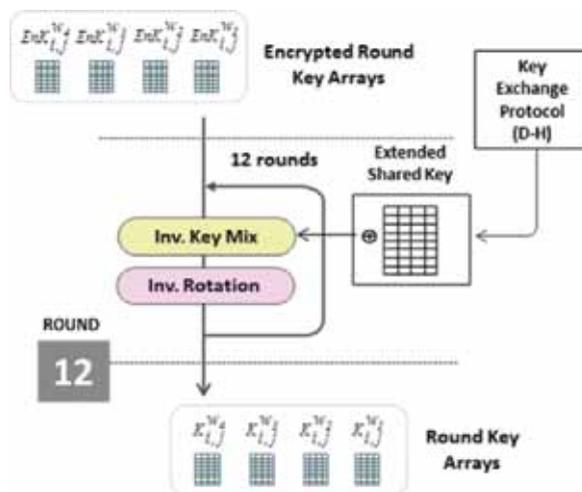


Figure 12 Key decryption model

If the inverse key mix operation (Inv. Key Mix) is expressed as in expression (26) then complete single round operation is expressed as in expression (27) and whole

decryption cipher is expression as in expression (28).

$$(26) \text{ Inv.Key.Mix}(b_{i,j}^{(r)}) = \text{En}K_{i,j}^{W_n} + \text{Ext}K_{i,j}^{W_n}$$

where  $\text{En}K_{i,j}^{W_n}$  -encrypted round key.

$\text{Ext}K_{i,j}^{W_n}$  -extended shared secret key.

Single round function is followed by expression (27).

$$(27) \text{ RnKey}^{(r)} = b_{i,j}^r * 32 - \left\lfloor \frac{b_{i,j}^r}{8} \right\rfloor * 255$$

The whole cipher decryption operation is as in expression (28).

$$(28) \text{ Key.Dec}(k_{i,j}^{W_n}) = \text{RnKey}^{(1)} \circ \text{RnKey}^{(2)} \circ \text{RnKey}^{(3)} \circ \dots \circ \text{RnKey}^{(12)}$$

The decrypted round keys from key decryption model are directly applied to inverse key mix transformation (Inv. Key mix) in the data decryption model.

#### 4. AUTHENTICATION

The authentication used in the secure model is knowledge based authentication for mobile host (MH)s in the mobile network. The authentication confirms every connection between the base station (BS) and mobile host (MH). It uses mobile host (MH) knowledge, relates with life questions of the mobile host (MH), to authentic system. Figure 13 illustrates the authentication structure. The life questions basically involve the “human aspect” of the authentication, designed to connect with semi-private user information garnered from user’s past time memo so that the answers of the questions are easy to remember. For instance, “What was your best friend’s last name? What was your first pet’s name? Who was your childhood favorite actor? Where did your mother born? What was your first phone number? Which place did your mother grow up? Who was your favorite singer? What is your birth date?”

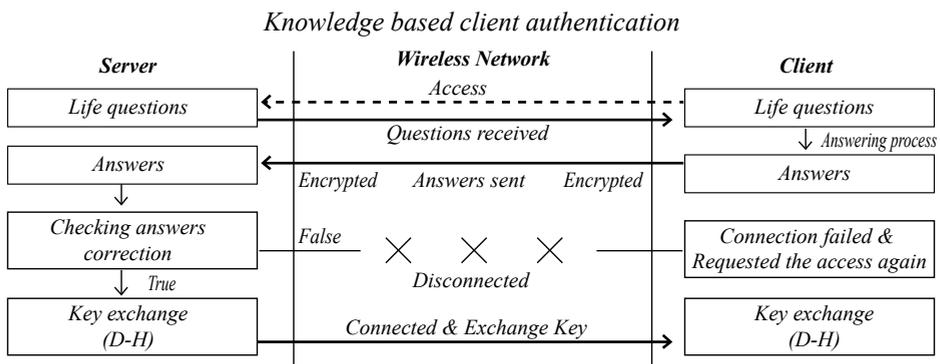


Figure 13 Authentication model structure

When mobile host (MH) accesses to the base station (BS), the mobile host (MH) authentication controls the access and pass several life questions to the mobile host (MH). The mobile host (MH) has to reply the answer which is routes back to base station (BS). If not, the mobile host (MH) access is denied and disconnected. The answers of the life questions from the mobile host (MH) are examined at the base station (BS). If the answers are all correct (true), then the base station (BS) keeps the connection and starts to exchange shared key to the mobile host (MH). Else, if the answer is wrong (false), the connection is terminated. When the connection is established, the key exchange and data encryption and decryption start without any problem. All these actions are to ensure the mobile host (MH) connection is secured; thus, to prevent the man-in-the-middle attack.

## 5. IMPLEMENTATION AND EXPERIMENT RESULT

In this section, the implementation of the MDTP is briefly presented. The model of the experimental work is important to improve the feasibility of our approach. There are some requirements in both the hardware and software. In term of the hardware requirement, one personal computer and two laptop computers are needed. The system model of this experimental work consists of a personal computer, which represents one of the sites with slices of the database, two laptops, which represents part of the mobile nodes ( $MH_1$  &  $MH_2$ ) in the mobile network and a wireless router switch, which represents as access point of the wireless network as illustrated in Figure 14.

Those mobile mobile host (MH)s/nodes can connect only with sites/base station (BS)s through wireless access point, and the wireless access point is connected to the base station (BS) by a wire line. A personal computer used in this model is represented as one of the wired line connected sites/base station (BS)s with slices of the database that is managed by MCTO technique.

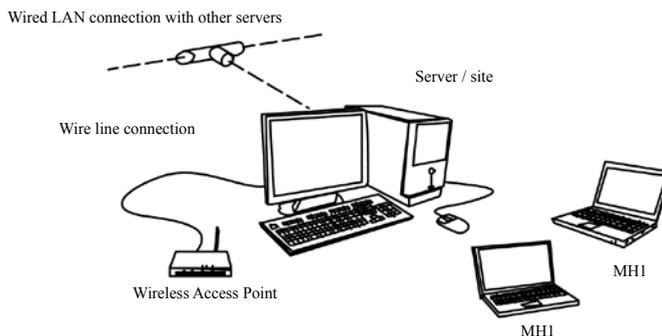


Figure 14 Experimental system model for designed

In terms of the software requirements, besides the operating system, the Java Run-time Environment (JRE) program is necessary to support the java coding application into the respective operating system. Next, the designed protection base station (BS) and mobile host (MH) models are installed at the base station (BS) and MH(s) respectively. Before the base station (BS) initiates the connection to the MH(s), there are several parameters that need to be set-up by base station (BS) application.

For the slice of database at the base station (BS), base station (BS) application initializes data object at the base station (BS). Figure 15 shows the interface of initialization setup for data object and timeout.

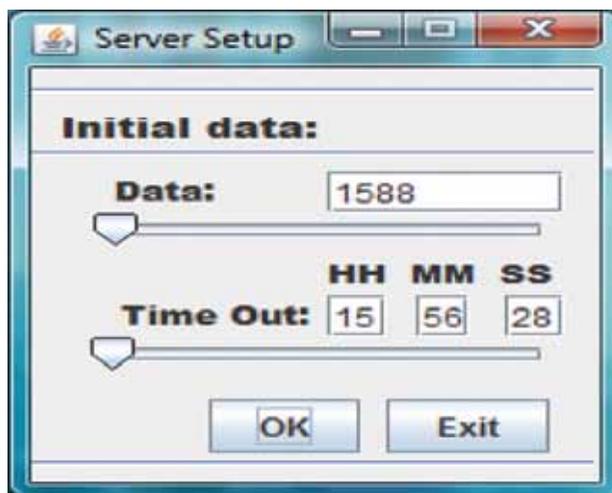


Figure 15 Initialize data and timeout session.

Once the parameters and data have been set-up, the base station (BS) starts to allocate database to the mobile nodes/mobile host (MH)s. The base station (BS) application panel shows the data status, encryption and decryption status. Through the data status, database process information is displayed such as the initial, current data objects, connection number from MH(s), current system time and time out for MH(s). The allocated data quantity and encryption process time are revealed at the encryption status and encryption table for MH(s). Besides, it also presents the update /sold, request data from the MH(s) and associated decryption time through the decryption status as shown in Figure 16.



Figure 16 Layout of the base station (BS) interface

In the base station (BS) interface, the database status, encryption status and decryption status appeared. The data status contains information about management for slice of the database, shows initial data object, current data object, number of the mobile host (MH) connection and the general table for DB. Encryption status shows the current and previous data encryption with mobile host (MH). Decryption status, however, displays decryption info of the received decrypted data.

Every connection from mobile host (MH) to base station (BS) is confirmed by the authentication system. Authentication system is displayed as shown a window at the mobile host (MH) site in Figure 17.



Figure 17 Authentication Layout

These questions need to be answered at the mobile host (MH) site. If it is not or any answer is wrong, access to the base station (BS) is denied, and the connection to base station (BS) is lost.

In the mobile host (MH) interface, there are few components shown such as, decryption and encryption status, and data status as depicted in Figure 18.

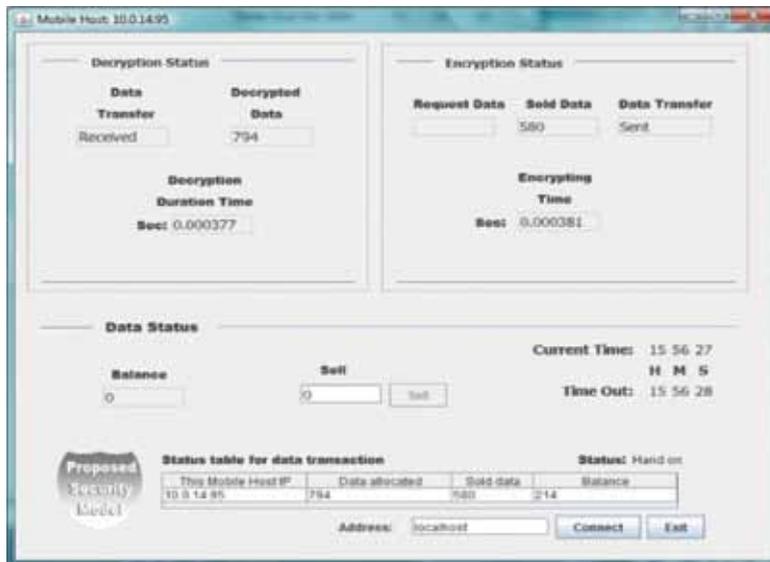


Figure 18 Layout of the mobile host (MH) interface

When the encrypted data is received, it is decrypted and displays the quantity of data and decryption process time through the decryption status. The data status section displays the balance/ (current quantity of data), sell/ (update data), data transaction table and connection section to the base station (BS). The balance can be updated locally within limit of the balance by using sell textbox and button in the data status section. The updated portion is stored as change/sold data. If update is more than the balance, request would be sent to the base station (BS). Otherwise, the change is only sent to base station (BS) when MH connects to base station (BS). Before the sending request and update data, they are encrypted while quantity of encrypted data and process time are appeared by encryption status.

Finally, ordinary MCTO and MCTO with data protection mode are compared through current data security condition as shown in Table 3. In the experimental result, encryption and decryption execution time of the protected mode with other similar cryptographic models are measured. The timing result is served for the encryption and decryption model. The comparison results are taken from 1000 looping

and the timing is taken from the average of the total time elapsed.

Model	Authentication	Data privacy	
		Encryption	Decryption
Ordinary MCTO	-usual mobile host (MH) authentication	-	-
MCTO with Protect Mode	Mobile host (MH) authentication (Knowledge based authentication)	Data and Key Encryption models (MDTP)	Data and Key Decryption models (MDTP)

Table 3 Ordinary and modified MCTO

## 6. CONCLUSION

This paper explores and compares the different mobile transaction models which are widely used. The short comings associated with these models are also discussed. The comparison of the models comes out with the lack of security mechanism in all of the models during mobile data transaction. Encryption is not a panacea for security. If we are not in control of the environment (the hardware, the operating system and all software running on that system) then we have no control over the security too. If we really need to protect the data or database then it need to retain security mechanism of the database and the mobile environment in which it is accessed.

This paper proposed, the Protect Mode for the MCTO model. The Protect Mode consists of the encryption and decryption models with authentication system and resides at base station (BS) and mobile host (MH) applications. The encryption and decryption models are also classified into (i) data encryption, (ii) key encryption, (iii) data decryption and (iv) key decryption model. The encryption model is used to encrypt data and round key before they are sent over the network. However, the decryption model decrypts the encrypted data and decryption key after they are received at the respective sites. The key encryption model includes the key exchange protocol to exchange shared secret key between the base station (BS) and mobile host (MH). The key exchange protocol is extended by mobile host (MH) authentication model which is based on the human knowledge to confirm every connection from the mobile host (MH) to base station (BS).

Through this paper, the design of the MDTP model is based on hybrid cryptography and took advantage of the symmetric and asymmetric cryptographies to keep

data transaction privacy between the base station (BS) and mobile host (MH)s. The model uses symmetric and asymmetric key encryption models that replaces each other' weaknesses and reach to the efficient result as compared to using single crypto system.

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**ACADEMIC ADVISING IN HIGHER EDUCATION  
INSTITUTIONS IN THE SULTANATE OF OMAN  
THE CASE OF IBRI COLLEGE FOR APPLIED SCIENCES**

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**ABSTRACT**

Officials in any higher educational institution lend academic advising great importance due to its direct impact on students' performance at the academic, scientific, cultural and social levels. Accordingly, CAS Ibri has placed a lot of interest in the academic advising process; assigning to the academic advisory committee the task of supervising, to the smallest detail, the way academic advising is being carried out in each department.

This paper comprises a general description of the academic advising process—including the main steps and measures taken in Ibri College during this academic year—and analyses the most serious problems pointed out by the students in this respect. It sheds light on the problems encountered by students on academic probation and discusses a number of suggested solutions. It also reviews the general challenges to the academic advising process, and concludes with some suggestions and recommendations to promote it and improve its quality in Ibri College as well as the Colleges of Applied Sciences as a whole.

## 1. INTRODUCTION

The academic advising process is an important component of the educational plan in any higher education institution [1]. It is, in fact, one of the essential activities in most universities, colleges and institutes. Not only does it effectively contribute to solving students' problems, but it also helps discover new talents, provides means for students to optimally use and develop their potential, and plays an effective role in instilling in students authentic intellectual values. Ultimately, it may provide the local community with a highly qualified workforce in academic, scientific, technical and social fields [5-7].

Effective academic advising contributes to promoting creativity and communication skills among the students. It reinforces the positive aspects of their personalities and inculcates in them the values of mutual support and team work. In addition, it helps them develop decision-making abilities and leadership skills, which will eventually provide society with active participants in the development process [6-9].

Academic advising is defined as "a systematic process based on a close student-advisor relationship intended to aid students in achieving educational, career, and personal goals, through the utilization of the full range of institutional and community resources" [17]. It is a central element for a student's academic success, no matter how much, if any, developmental education is required.

Researches and specialists spared no efforts analyzing the academic advising in higher institutions, and demonstrating its importance and effects on the entire academic process. Many researchers tried in early stages to develop models for academic advising, which can be used and benefit from, in other institutions. In fact, in 1972, Burns B. Crookston wrote an article in the *Journal of College Student Personnel* titled 'A Developmental View of Academic Advising as Teaching'- and the term "developmental academic advising" was born.

Developmental academic advising is both a process and an orientation. It reflects the idea of movement and progression. Developmental academic advising recognizes the importance of interactions between the student and the campus environment, it focuses on the whole person, and it works with the student at that person's own life stage of development. Numerous authors [17-20], show that developmental advising is grounded in theory, including cognitive developmental theory, psychosocial theory, and person-environment interaction theory, as well as in theories that focus on specific populations.

Many researchers [18-21], focused on the difference between prescriptive and developmental advising. In prescriptive advising, a student would come to an advisor for a solution or an advisor would typically answer specific questions but would not address more comprehensive academic concerns. Developmental advising is based on ‘the belief that the relationship itself is one in which the academic advisor and the student differentially engage in a series of developmental tasks, the successful completion of which results in varying degrees of learning by both parties.’ Moreover, five main steps had been identified as ‘the dimensions of the process of academic advising’ [20, 21], they included: exploration of life goals; exploration of vocational goals; program choice; course choice; and scheduling classes.

According to most researchers [1-9, 25-27], culture and environment play a vital role in determining the nature of the academic advising and the appropriate model which should be followed. What is suitable for Western university students might not be fully suitable to Middle-East university students. Therefore, the environment in each institution should be thoroughly studied and analyzed, the culture and different backgrounds should be taken into account when implementing any advising model, or developing any means and measures to apply an effective academic process.

In fact, Academic advising practitioners must recognize the environmental implications of their offices and understand how they influence student learning [27]. Examples include the chairs on which students may sit for a period of time; the characteristics of staff members working in the office; the reputation of the office among members of the campus community; and the policies that are in place. Academic advisers serve an important role regarding students’ current and future plans in college. To ensure continued learning and growth, it is crucial that academic advising programs maximize efforts to assist students by evaluating their office environments [27].

In light of the above, special studies and researches should be conducted in order to address the individual characteristics and cultural elements in the Gulf region higher institutions. The different backgrounds of Gulf students should be analyzed and taken into consideration when performing any study related to academic advising process.

In fact, a number of research studies have been conducted for some Gulf region higher institutions. The scholars have actually been sensitive to the importance of academic advising and the major problems it is facing. One prominent scholar is Dr. Haya Saad Al-Rawaf, College of Education, King Saud University, who explored the factors leading to student failure in female colleges under the Ministry of Higher

Education [5]. Her study was limited to female students and the results and findings cannot be generalized. Moreover she did not discuss the whole academic process in depth.

Mention may also be made of Mrs. Hanan Abdullah Al-Kuwari's study of Bahrain University's Academic Advising experience [6], which demonstrated that the number of dismissed students from the university has increased dramatically during the last years, due to their low academic performance. This study indicates the importance of the role of academic advisor to help those students by registering the right courses in the right time, which will improve the academic performance of those students and hence reduce the number of dismissed ones. However, this study did not examine the academic advising process in its wide range. It was, merely, restricted to the process of helping students in registration of the courses.

Other scholars, such as journalist Nasser Al-Hujeilan, wrote about the academic advising process in higher institutions in the Gulf [8, 9]. Those writings indicated the importance of the academic advising process, and the crucial need for more researches and studies to be done on this topic, and that further time and energy need to be invested in it.

“In spite of their differences, all above-mentioned scholars and researchers agree that, the academic advising process in any higher education institution is based on a number of key components or pillars which are: the teacher, the student, the regulations in force and the non-academic departments (which actually provide several facilities and services). In order to stimulate the academic advising process, awareness has to be raised in all the people concerned (pillars of the academic advising process), and necessary facilities need to be provided at every level [8-15].

In order to achieve the mentioned above goals, a field study has been carried on. In Ibri College for applied sciences, the feedback of faculty members and students were collected and analyzed. Based on that, conclusions were made, and recommendations were given.

## 2. STUDY METHODOLOGY

### 2.1. Population and Sample

Even though our analytical field study was about the Colleges of Applied Sciences in Oman, our focus was specifically on Ibri College. The population of this study consists of all students in Ibri College for Applied Sciences, which exceeds 1300 students.

To make this study more practical a sample of students was taken. This sample included all students in IT department whose number exceeds 320 students. The reasons behind selecting IT students as a sample for the field study are:

- IT department is the largest one in the college.
- Ibri College is considered as a center of excellence (specialization) for IT, whereas some specialization, such as communication, has been phased out, and IBA will be phasing out in the year 2013.
- All students in Foundation Year (around 350) are not subjected to the academic advisory process, which means that Foundation students are not assigned to an academic advisor. Consequently this number of students should be eliminated and cannot be involved in such studies.
- Around 80% of students, under academic probation, belong to IT department. Remembering that investigating the causes behind being under academic probation is one the main objectives of this study, selecting IT students as a sample for this study is reinforced.
- IT department includes four majors: software development, data management, networks, and security, which gives the study a diversity of the backgrounds of students and faculty members.

This sample of students was distributed amongst the academic advisors in groups of around 20 students each. This distribution was made by the center of Admission and Registration. It is a part of their routine job to distribute the students in each department amongst the faculty members of the same department. Each advisor is fully responsible for following up all issues related to the academic advising process for his group. The sample groups comprised different profiles, such as male and female students, arts and science majors, public and private school graduates, and students with varying academic skills and results.

On the other hand, the study sample, also, included all students on academic probation, in the college, whose number exceeded 47 students for the academic year 2011-2012, from them, there was 33 students belonging to IT department. Table 1, shows the distribution of the students under academic probation amongst the academic departments.

**Table 1.**

<b>Department</b>	<b>Number of Students</b>
Information Technology	33
Design	13
International Business Administration,	1
Total	47

More than 80% of the whole sample belonged to the IT department, being the largest department in the college. It is to be noticed that the students constituting the sample groups were from different social backgrounds, which reinforces the exhaustive character of the study and makes its results more suitable for generalization.

## **2.2. Research Tools**

In this field study several research tools were used, this includes the following:

- ▶ Personal interviews
- ▶ Periodic individual and group meetings with students
- ▶ Analyses of different academic advisor reports
- ▶ Discussions with academic advisors

Personal interviews were held with students under academic probation. According to the current procedures in the Colleges of Applied Sciences, a student is placed on probation if their GPA falls below 2.0 (i.e. 65% on a percentage scale) [16].

The personal interview is held by each supervisor with his students under academic probation twice a month. In this interview the advisor should fill a special form called a follow-up form.

For validity and reliability purposes, the follow-up form was designed by the college level-academic advising committee, and was revised by the Admission and Registration Center. Then, it was sent to the research department, the heads of academic departments, and 5 of faculty members who have a rich experience in aca-

demic advising aspects, to seek their feedback and comments. The form was revised by the mentioned parties and comments were collected and analyzed. Based on that, the original form was modified, to end up with the final version of the follow-up form which was used later by the advisors.

The follow-up form should be filled with information indicating the performance of that student during the targeted period of time, such as continuous assessment (marks that student gained during that period, in any of tests, quizzes, assignments, projects,...), rate of absence from the classes, any delay of submitting assignments or homework, problems raised by the students during the interview, need for any special measures to be taken, such as extra classes and lectures, in addition to remarks from the supervisor.

Periodic meeting with students of normal academic performance were held on monthly basis. The last Monday of each month was assigned for such meeting by the advisor with his group of students during the activity hours from 12-14 p.m. The number of attendees in such meeting varies between 10 -17 students in each group. In order to keep high rate of attendance, different communication tools of announcement and contacting students were used, this includes, SMS, email, hardcopy announcement on special boards in the college, and announcement using plasma TV.

During those meetings, advisors used open- type questions, and they listened to the comments and problems raised by students which are related to the teaching process in the college and the academic performance of the students. Advisors discussed those problems, explained to students and gave them the required and suitable advice. Meanwhile advisors classified the problems and comments, raised and wrote the required reports, to be submitted to the college-level academic advising committee.

To make the findings more reliable, regular meetings, on monthly basis, were held with academic advisors to discuss issues related to the academic advising process, as a whole, and problems raised by regular students and by those under academic probation.

### **2.3. Investigation Procedures and Analyses**

It would be useful at this stage to review Ibr CAS's modus operandi with respect to academic advising. As mentioned earlier, we will examine a sample of procedures in IT department since it is the biggest department in the college.

Among the most important efforts carried out in 2011-2012 in the IT department, we may mention the following:

- ▶ The academic advising process and the situation of students on probation were discussed in department council and other meetings.
- ▶ New faculty members were familiarized with the principles and nature of the academic advising process.
- ▶ Students on probation were called to meetings, each with his/her own academic advisor, at least once every two weeks.
- ▶ The chief academic advisor met the students on probation, listened to them and urged them to give academic advising due importance and attention.
- ▶ A special follow-up form was designed for the purpose of recording the most important points that were discussed with students on probation during those meetings, such as their general academic performance, absence rate, previous exams and results, and related problems.
- ▶ Faculty members in all departments received a copy of the form and were familiarized with its content.
- ▶ Based on the issues raised in some of the follow-up forms, some measures were carried out, such as giving extra classes to weak students.
- ▶ Extra-lectures were organized in some subjects including mathematics, data bases and programming.
- ▶ A lecture on revision and the preparation for exams was organized.
- ▶ The student activity hour of the last Monday of each month was fixed as the official academic-advising time in the IT department for all students, each with their own advisor.
- ▶ Upon the chief academic advisor's advice, some of the outstanding students in the college gave remedial lessons and provided assistance for their less successful classmates, especially in mathematics.

Based on analysis of the follow-up, academic advisors wrote their reports about the students under academic probation classifying problems and mentioning their recommendation to help the students of this category.

Based on the measures and actions, mentioned above, advisors wrote their individual reports about academic advising process, which also included comments and problems raised by the regular students. Those comments should be written in an organized and classified manner. Advisors also included their feedback, comments and recommendations. All faculty members in the IT department were involved in this research tool.

The college-level academic advising committee received the individual reports from the faculty members, combined, analyzed them, classified all comments and problems, and came up with a common (general report). Analyzing this report, conclusions were made and remarks and recommendations were given.

In order to reach more precise conclusions, and to improve the academic advising process as a whole meetings were held and discussions with some of the advisors were conducted on semester basis (twice in the year). All faculty members with experience of more than 4 years in the colleges of applied sciences were scanned. From them, two advisors for each level were selected arbitrarily and invited to those meetings and discussions.

In those discussions open-type questions were addressed. Academic advisors were asked to respond to the following 5 questions:

- What are their primary responsibilities for advising regular students and those under academic probation?
- When and how does advising takes place?
- What is the advising system's major strength?
- What is the advising system's major weakness?
- What actions can be taken to address the system's major weakness?

The answers for those questions were received and analyzed, and proper recommendations were given, as mentioned in the following sections.

In addition, this study has benefited from reviewing of reports about the academic advising process prepared by the college for the Ministry of Higher Education during the last few years.

### **3. FINDINGS AND RESULTS**

#### **3.1. Common Problems Pointed out by Students**

Many students agree that the academic advising process suffers from problems common to all students. Some of these have been particularly acute for a number of years, while other problems are of a rather chronic character.

Among the most important problems that were raised by the majority of students, we may mention the following:

- ▶ A number of groups were amalgamated in some subjects, which had a negative impact on the students' self-confidence as well as their academic performance.

- ▶ The number of students per class is quite high, which relatively affects the quality of lectures and practicum.
- ▶ There is a quite widespread ignorance, among the students, of the available sub-majors within each department, which has had a negative effect on many students' choices.
- ▶ Students initially suffer from a lack of a sound foundation in mathematics, while the present programs lack a sufficient number of mathematics courses and classes in the IT and IBA departments. Previous research in the field actually pointed out the importance of a sound basis in mathematics for the students' overall performance at the higher-education level [2,3].
- ▶ The Software sub-major in the IT department lacks sufficient Programming courses.
- ▶ Students do not have a realistic picture of the job market.
- ▶ Students are overburdened with a large number of difficult subjects that relate to areas of specialization other than their own.
- ▶ Some students find themselves compelled to register in an area of specialization that they do not want.
- ▶ Several final exams are sometimes scheduled on the same day.
- ▶ There are too many mid-term quizzes and exams throughout the semester.
- ▶ The media networks and computers in some labs suffer from frequent breakdowns.

### **3.2. Students on Academic Probation**

A review of student results in the Colleges of Applied Sciences over the last few years has actually shown that the proportion of students on academic probation is relatively large. Officials in charge have indeed deployed keen effort to find adequate solutions to this problem. In Ibrahimi college of Applied Sciences, attempts have been made on at least three levels:

- ▶ The academic department itself; through a number of measures mentioned above.
- ▶ Admission and Registration; by helping students make the right choice while registering for different courses.
- ▶ The Assistant Dean for Academic Affairs and Research; through several counselling meetings.

In this respect, we have conducted a thorough study in which we scrutinized every possible factor relating to student performance in general and students on probation in particular. The study has revealed that most of the reasons behind the large number of students on academic probation are divided into:

- ▶ Formal / procedural factors
- ▶ Academic and practical factors

The formal-procedural factors are basically related to the grade scale and the way the GPA is worked out, which actually falls outside the scope of this study.

Significant facts about the academic and practical factors- that often lead to academic probation- have been pointed out in the course of the academic advising process. These will be dealt with in more detail throughout this paper.

### **3.2.1. Specific Problems Raised by Students on Probation**

In addition to the common problems pointed out by students in general, a number of problems were specifically raised by students on academic probation, among which:

- ▶ The summer session is organized in only one college, which is quite exhausting for Ibri students.
- ▶ During the summer session, some students feel that they are not treated in the same way as some other students, as teachers tend to focus on students of the college in which they work.
- ▶ Some teachers give instructions and explanations too quickly to allow a thorough comprehension of the lecture.
- ▶ Some courses are excessively dense and contain a huge quantity of scientific material.
- ▶ Teachers are too strict in assessment and marking.
- ▶ Students on probation have a feeling that they are not being given enough attention by the various college departments, including the academic and administrative departments as well as Admissions and Registration.

## **4. DISCUSSION**

### **4.1. Causes of Academic Probation (from the point view of the academic advisor).**

The analysis of available data, and examination of every single case over a relatively long period of time, and comprehensive discussions with academic advisors, have led us to conclude that a set of reasons lie behind some students' probationary status.

The following are the most important ones (from the point view of the academic advisor):

- ▶ The admission of arts students, and those with poor grades, in the IT department. These students initially lack the skills to manage scientific subjects-which inevitably leads to further problems at the tertiary level, as confirmed by research studies that focused on the relationship between school education and academic performance at university level [4].
- ▶ The sheer weakness exhibited by most of these students in mathematics.
- ▶ As a matter of fact, in majors such as IT, accounting and administration, a minimum level of competence in mathematics is absolutely required.
- ▶ (Another field study we had undertaken in Sohar University underscored the fact that students' overall scientific skills and their ability to understand mathematics were closely linked. It also asserted that there was a direct link between the student's ability to understand mathematics and his/her overall intellectual development. The study highlighted the fact that intellectual development is actually responsible for every achievement that may contribute to promoting urban and industrial progress, increasing overall production, improving the economy and raising the standard of life and the national income) [2,3].
- ▶ The fact that some students are compelled to register in one area of specialization against their own preference, especially in the IT major, because it is the only one left.
- ▶ Physical and psychological health reasons in the case of some students, which weakens their ability to focus and learn.
- ▶ The utter weakness of most students in English language, which seriously hampers their ability to learn, as English is the medium of instruction in CAS.
- ▶ This study has shown that this problem is worst in the Communication and

International Business Administration departments.

- ▶ Social and family problems which compel some students to reconcile their studies with social commitments that drag them away from the academic environment.
- ▶ Frequent and recurring absences and tardiness of some students.
- ▶ The excessive shyness of some students, which prevents them from asking questions in class and interacting with their classmates.
- ▶ The weak content of the mathematics courses in the IT and IBA departments; the shallow content of the Programming courses in the IT department and their lack of sufficient weight and hours.
- ▶ Some defects in the curricula; for example, some courses do not follow a correct sequence, while others are scheduled in the absence of any related prerequisite courses.
- ▶ The excessive amount of exams throughout the semester, which creates unnecessary pressure with which some students are unable to cope.
- ▶ The fact that too much time and energy are spent on studying subjects from other departments, which ultimately prevents students from developing a sound basis in their own areas of specialization.
- ▶ Some students' exaggerated involvement in the college's cultural activities, which sometimes occurs at the expense of their academic performance.
- ▶ The central character of final exams.
- ▶ The late-joining of some students; (a few weeks sometimes).
- ▶ The teacher's and academic advisor's lack of sufficient time to give these students enough attention.
- ▶ The fact that some courses fall outside the teacher's precise area of specialization, which has a negative impact on the teacher's performance and the students' learning.

## **4.2. How to Help Students Getting Out of the Probation Status**

The following are a number of suggested solutions to help decrease the number of students on probation, most of which relating to the above-mentioned problems:

- ▶ To find a better procedure of enrolling students in the various areas of specialization-which must take into consideration their actual academic abilities and

personal preferences.

- ▶ To organize remedial courses that arts students and low-achievers must pass, especially in mathematics, in order to bridge the gap between their level and that of other students.
- ▶ To make improvements on the present curricula by adding more mathematics and Programming courses and increasing the number of class hours in these courses.
- ▶ To reduce the number and density of other departments' courses in the curricula.
- ▶ To fix the defects of the present curricula by ensuring that the correct sequence of courses is applied and the right prerequisites for each course are scheduled.
- ▶ To organize the necessary training courses to improve these students' English language skills, especially in the Communication and IBA departments, with a particular emphasis on relevant ESP (English for Specific Purposes) in each area of specialization.
- ▶ To take more strict measures against absenteeism and tardiness.
- ▶ To be very meticulous when assigning courses to teachers, especially by taking into consideration each teacher's precise area of specialization.
- ▶ To reduce the number of exams during the semester.
- ▶ To prohibit the practice of late-joining.
- ▶ To understand students' social and psychological problems as a first step towards looking for solutions and providing assistance.
- ▶ To seek the assistance of outstanding students who may be able to understand their fellow students' problems better than the academic advisor him/herself.
- ▶ To promote academic advising in the various departments by giving it enough time and attention and raising interest in it among teachers and students.
- ▶ To stimulate a high level of cooperation between all departments in the college-academic and non-academic alike in order to achieve the above-mentioned goals.

Taking the actions and measures mentioned above, the number of students on academic probation in the college has been significantly reduced. Statistics showed that 9 students managed to get out of this status, and 3 students were transferred to

diploma program, which means the number of students on academic probation has been reduced by 27%, whereas the GPA of the rest students has been improved. Table 2, shows the numbers and current status of students who were on academic probation for 2011-2012.

**Table 2.**

Department	Total num. of std. on probation	Std. graduated	Std. transferred to diploma prog.	Stud. Succeeded Getting out of probation	Std. still having last chance	Std. still having last chance	Stud. having more than one chance
Information Technology	33	1	3	7	2	1	19
Design	13			2	0		11
International Business Administration	1				1		
Total	47	1	3	9	3	1	31

### 4.3.General Obstacles and Challenges that Academic Advising is Facing

Analyzing the individual reports received from faculty members and the results of the discussions with the selected staff members, it was found that more than 70% of the faculty members think that academic advising process in Ibri College, as well as in other colleges, is facing serious problems and challenges that often prevent it from fulfilling its goals in the best possible ways. Around 80% of the faculty members think the time allocated for this important issue is not enough, this due to the heavy teaching load assigned to them.

Around 65% of the faculty members think that students under academic probation should not be allowed to register in the courses without the permission or approval of the advisor. Taking into account that the registration of courses is online, this makes the involvement of academic advisor in the registration process difficult.

Generally, faculty members think that, the academic advising process, in Ibrī College, is going in the right track. However there are many obstacles and challenges facing this process which need to be addressed, analyzed, and solved.

Among the most important challenges are:

- ▶ The low level of communication between academic advisors and their students
- ▶ The difficulties that usually impede this communication, such as the lack of suitable time and space, etc.
- ▶ The low efficiency of the means by which students are informed about meeting times—because of the complicated procedures involved—whether these be telephone calls, text messages, the electronic board or the old notice board.
- ▶ The heavy teaching load of academic advisors, which often results in reducing the time devoted for academic advising.
- ▶ Many students' lack of interest of in the academic advising process—and sometimes the lack of belief in its actual efficiency or even its very *raison d'être*
- ▶ Lack of cooperation amongst the six colleges regarding academic advising issues.
- ▶ Some teachers' scanty awareness about the importance of academic advising in the higher education process
- ▶ The academic departments' lack of stability with respect to their teaching teams. As a matter of fact, it takes new teachers a considerable amount of time to be familiarized with the new environment, including the specific character of academic advising in the college.
- ▶ The big number of students assigned to each academic advisor.
- ▶ The low level of coordination between the different college departments in this respect.
- ▶ Need for forming a central committee, on the directorate level, that can take the full responsibility for academic advising in colleges, including: planning, coordination amongst colleges, training and enhancement.
- ▶ Lack of studies and researches about academic advising in higher institutions in the region.

#### **4.4. General Recommendations and Suggestions to Improve the Academic Advising Process**

In order to improve the academic advising process and make its role more efficient in Ibra College as well as in other colleges, the following suggestions and recommendations need to be taken into consideration:

- ▶ To form a central committee, on the directorate level, whose responsibility to follow up and supervise academic advising process. This committee should have the upper hand in making decisions related to academic advising issues in colleges. Preferably some of senior managers, in the directorate, to be involved in this committee.
- ▶ To form an academic advising committee in each college, under the supervision of the assistant dean for academic affairs and research. This committee will liaise with the central committee in the directorate, and with academic advising teams in the departments.
- ▶ The central committee to put the general guidelines and policies for academic advising by consultation with the colleges themselves.
- ▶ The central committee to organize regular workshops and training courses for those faculty members who are heavily involved in academic process (chief advisors).
- ▶ The central committee to insure the synchronization amongst colleges with regard to academic advising process, and to insure good and strong communication and cooperation amongst colleges in this regard.
- ▶ Central committee to held regular symposiums (yearly or once in two years) to discuss the experience of each college in academic advising process.
- ▶ Taking into consideration that culture, environment, and students backgrounds are similar in all six colleges, each college can benefit from other experiences.
- ▶ The central committee to analyze, thoroughly, the annual reports submitted by individual colleges and to modify academic advising policies according to the comments and suggestions given from the field.
- ▶ To raise the students' awareness about the importance of the academic advising process. This may best occur through introductory lectures and educational seminars, as well as the efficient use of orientation-week activities for this purpose.
- ▶ To develop a data base for academic advising issues in each college for the last

few years. This database should be dynamic and subjected to updating each semester. It will include the number of students in each department, the number of students under academic probation, the distribution of students amongst the teachers, the number of dismissed students each semester, number of students who succeeded to leave under probation category, and any other relevant information. This database will benefit the researches in conducting more comprehensive studies in the future.

- ▶ To put the academic advising issue as a constant and regular point on the agenda of the department academic councils.
- ▶ To further improve the teachers' awareness about the importance of academic advising in the overall academic process and the significance of their role therein.
- ▶ To urge teachers to give the academic advising process more consideration, time and effort. This will only happen if the teaching overload is alleviated.
- ▶ To ensure that a chief academic advisor is appointed in each department and that his/her teaching load is reduced. This is quite necessary at this stage, especially if we consider the fact that the IT department in Ibri College, for example, comprises 28 teachers who all need some sort of follow-up in the academic advising area.
- ▶ Academic advising committee, on the college level, to held regular meetings to discuss the reports received from academic departments, and to follow up academic advising process.
- ▶ To promote cooperation between academic departments, the administration, the services department, and the Admissions and Registration for the success of this process.
- ▶ To solve the problem of communication with the students by making the available means of communication more efficient.
- ▶ To reduce pressure on students by decreasing the amount of mid-term exams.
- ▶ To widen the scope of academic advising to encompass more positive aspects, such as discovering and promoting student talents rather than just focusing on problems and their solutions.
- ▶ To involve outstanding students in the academic advising effort and give them a more prominent role therein so that they can better assist their less successful fellows.

- ▶ To consider the academic advising process within the framework of a precise plan.
- ▶ To get in touch with the experiences of other higher education institutions in this regard and take advantage of what is relevant for the college.
- ▶ To encourage students and teachers to participate in conferences and forums that deal with academic advising.
- ▶ The academic advisors should have the degree plan for his students in their files, to be revised with them during personal meetings.
- ▶ Academic advisor to prepare a remedial plan for students under academic probation and to discuss it with registration center.
- ▶ Academic advisor should provide the supervisee with the advising manual at the beginning of academic year.
- ▶ To develop measures and policies which insure involvement of the academic advisor in registration process, especially for students under academic probation. This can be done by keeping their registration in SIS pending till the approval of the academic advisor.
- ▶ The academic advisor should keep a copy of the registration form, add/drop form, withdraw form, and any other related documents for the student in his file for future needs.
- ▶ The academic advisor should follow up and analyze the performance of the students under academic probation and to record the progress, if any, and update the assistant dean for academic affairs of that.
- ▶ The admission and registration center should notify the parents of the students who fall under academic probation. This can be done orally in the first time and in writing in the second time of being under probation.

## 5. SUMMARY CONCLUSION

Academic advising is one of the most important activities in any higher education institution. Not only does it play a key role in solving some of the students' most serious problems, it also performs a significant part in highlighting students' abilities and talents.

In this respect, our study specifically focused on Ibri College and tried to underscore the most important measures and procedures implemented in 2011-2012, including the attempt to organize academic advising through a set of periodic meetings

held the last Monday of every month.

Within this framework, the study summarized the most important problems pointed out by students in this college, namely: the amalgamation of groups weeks after the beginning of the academic year, the absence of a clear picture of the job market, the small number of teaching hours allocated for the mathematics and Programming subjects, the large number of courses from other departments, the large number of students per class, the large number of mid-term exams, and the repeated breakdowns in some labs.

This study also discussed some problems pointed out by students on probation; specifically, the fact that the summer session is often organized far away from Ibri College, the huge quantity of scientific material in some courses, the fact that some teachers give lectures and explanations too quickly to allow a thorough comprehension, and the fact that this category of students is not given enough attention by the various college departments.

This study also analyzed the most important reasons—from the point of view of the academic advisor—leading to the probation status, among which are the way students end up registering in a particular area of specialization that might not be the one they want; social, psychological and health problems; the sheer weakness of most students in mathematics and English; and some deficiencies in the courses and curricula. On that basis, we presented a number of suggestions to help students out of this category, such as focusing more on mathematics and programming, motivating these students further, reinforcing the academic advising process within each department, and taking the precise area of specialization into consideration when allocating courses to teachers.

This study also discussed the most important challenges and problems that the academic advising process is facing in Ibri College as well as other colleges, mainly: the low level of communication between academic advisors and their students, the difficulties that usually impede this communication, the heavy teaching load of academic advisors, the lack of interest of many students and some teachers in the academic advising process, the constant change of teachers, and the low level of cooperation between the various college departments in this respect.

The study concluded with a series of suggestions and recommendations to improve the academic advising process, including forming a central committee- on the directorate level- to supervise and enhance the academic advising issues, raising the teachers' and students' awareness about the importance of the academic advising process and their important role in making it more successful, urging teachers to give

the academic advising process more consideration and time, appointing a chief academic advisor in each department while reducing his/her teaching load, promoting cooperation between the different college departments, overcoming communication problems with students, decreasing the number of mid-term exams, widening the scope of the academic advising process so that it helps highlight the students' abilities and talents, involving outstanding students in the academic advising process, getting in touch with other experiences in the field, organizing lectures and events about the job market and employment opportunities, and encouraging teachers and students to participate in such events.

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## STRATEGIC PARTNERSHIP BETWEEN BUSINESS EDUCATION AND INDUSTRY

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### ABSTRACT

Higher education institutions in general and business schools in particular, have to pay special attention in establishing partnership with industrial and commercial companies for the purpose of ensuring their successful performance. Continuous co-operation with the business sector and labour market will upgrade educational programmes up to the labour market requirements as well as provide employment to graduates. The proposed model of partnership reflects the engagement of employers with the business educational programs. The partnership between labour market and business education can contribute to benefit both business schools and labor market.

Such partnership enables the higher education institution to enhance its competitive advantages and improve the quality of education the institution provides, as well as to meet the labour market demand for specialists in various spheres of business and science. Business school gains a power tool in restructuring education according to the need of the workforce and the industry will have the opportunity to add value of its operational system by recruiting competent graduates who have built their capabilities according to the cooperative system. Integrated curriculum and innovative instructional strategies and specifically, the curriculum project-based nature can be applied to build the bridge between labor market and business school programs. The basic advantage of partnership models and applications is to offer solid lists of skills which are most important for business graduates, the breadth and depth of these skills change based on the type of curriculum consistent with the labor market and the methods in implementing the curriculum.

This paper emphasizes on the strategic partnership between Business Education and labor market by implementation of effective mechanisms of cooperation between business schools and industry. The suggested models of this study are establishing and measuring the competencies required by business departments and schools; designing an integrated context business curriculum; and setting partnership system and procedures.

**Keywords:** Business Education, Industry Partnership, Integrated Business Curriculum

## INTRODUCTION

There are several environmental forces that have been influencing the management education and its pedagogy. Most of these forces are emulating from technological advancements and hence the requirements of up-to-date skills, capabilities and knowledge. Such skills, capabilities and knowledge that are affecting the real business and organizational performances must be embedded in the business curriculum to achieve the competitive advantages. It is worth mentioning that the business environment, labor market and business education-related forces would be considered as both challenges and opportunities in the meantime. Building effective relationship between business education and industry will assist the faculties of business education in planning their graduates' attributes and performance capabilities in the actual businesses. Thus focusing on continuous improvements of pedagogy in conformity with the requirements of industry is the cornerstone of quality business education.

To achieve the goals and mission of a business educational Programme, it would require integrated interlink with the requirements of the labor market and by concentrating on the learning outcomes. Collaborations between students, institutions and business leaders will integrate the management education and the expectations of labor market. Such integration reflects the interdependence of research and exchange of knowledge between the business school leaders (Dean and faculty members) and business leaders (CEO and Senior Managers) leading to increasing the quality of education and the level of business success at the society. Some universities in the developed countries have achieved an excellent collaboration with the industry. Higher education institutions in the developing countries are now encouraged by their governments to develop and build the partner strategies with the industry (<http://www.unesco.org/iiep>, 2000).

Over the time, two different fields have been built between Institute and Industry [industry is also often termed as Enterprise]. The first one is to acquire feedback on business school teaching effectiveness through cooperative learning programmes. The second is about the potential value in academic research; and whether or not business school researchers are focused on the topics most relevant for business. For example, research in the field of marketing requires deep practical analysis to the situation based on the theoretical framework of marketing management. (AACSB International, 2006)

Education looks at the general development of students that gives them a wide range of opportunities and choices to prepare them for work after graduation; and industries look for specialised skills and knowledge that would fit directly into the system. Having this obvious discrepancy in their respective goals seemingly, there is a need to create a proper contact where institutes and industry would exchange views on regular basis. Forms of interaction can also take place in the form of collaborative researches, pre-employment and in-service training programmes.

This research paper focuses on the partnership between the business education and industry which takes several directions such as:

1. Business leaders serve in the Business Schools' Boards, participate in educational activities and advise the Business Schools on business educational vision and mission.
2. Interface of industries and Business Schools can design curriculum and teaching methods precisely according to the skills, knowledge and abilities that are required in the labor markets. Industry specific curriculum would brand a specific business school as a center of excellence.
3. Undertake of Industry centered collaborative researches and projects by faculty and students, sharing of knowledge that would boost the competitive advantage at both the sides. Arrangements of consultancy services and short courses to the local industry by the business schools will also enhance the partnership between the business education and industry.

Blackman and Segal (1993) refer to the most important benefits for higher education institutions in general to engage with the industry which are: to attract funds for research, to have access to up-to-date equipment, to improve training and employment opportunities for students, and to enhance the HEI's image as contributor to economy.

Institutions that do this will not find the task easy or fast. They will need to create an environment within which staff are rewarded for identifying relevant applications of knowledge intended to be of use to industry, business, governments, communities and the professions. It will also require faculty members and the institutions themselves to see collaboration with others as central to all that they do. Collaboration and co-production will allow "modern" universities the opportunity to embed themselves more fully within the economy through a series of innovative, multi-layered partnerships.

## Research Problem and Importance

Partnership between business sector and business schools is incredibly important in producing high quality outcomes (graduates) who will contribute in the economic development.

Business school can't have the sole responsibility for preparing the students to the real work environment as it requires a good integration of theories, practices and work-oriented learning. Business schools carry out their goals to facilitate learning, preserve a protected zone for students and nourish individual care to address the needs of the learners. The industry, on the other hand, work within the framework of industrial practices and norms with production, efficiency and profitability as the basic premise of day-to-day operations.

The characteristics of the workplace as the supreme learning environment must be coordinated properly to ensure that there is a close correlation between the types of training that the workforce is being prepared for vis-à-vis the work environment, tasks and work systems. The institutions' objectives must meet the expectations that industries regard in the context of finding the best in the pool to help them achieve industry goals. To integrate industrial training and other inputs from the industry with the teaching-learning processes, interaction is necessary as it develops students' awareness on job functions in the industry, attitudes to adapt to industrial environment, proper practical and relevant knowledge, skills and competencies in preparation to becoming self-employed. (Atienza, T. 2008)

Mutual benefit is derived from the shared expertise and experiences between the industry and the institute. In addition, operating within the framework of a specific cooperative program is an essential outcome of having both industries and institute agree on specific skills training for some specific jobs. A study by Anderson and Kosarek in (1997) concluded that the industry can provide technical programs, and total quality management training to strengthen the graduates' attributes required by the industry.

The success of business education in business world depends upon the involvement of business education and labor market effectively to enhance the required knowledge in the curriculum. A solid partnership between business schools and employers would be more informed and attuned to what potential employers want their new hires to know. Employers would realise substantive advantages by bringing on board graduates who, because of their finely tuned preparation and competence, would be quicker to add real value to the enterprise. Business schools and their students might find their programs increasingly vital and relevant, and stronger rapport between these partners might foster even more interaction between students and

the business world and its leaders. Through sustained, meaningful connections with business schools, industry would also reap the benefits of closer ties to research and communication with intellectual leaders. As a result of their invigorated growth and capacity, enterprises could, in turn, give back to their communities and stakeholders at an even higher level.

Two frequently appointed reasons for employers to be interested in participating in educational partnerships are, (1) to prepare for existing or project workforce skills, and (2) to enhance community relations to develop Career competencies. (McNeil and Kulick, 1995)

The main issues to consider in building and sustaining a good partnership between business school and employers, is the return expected whether recently or in the future. A Positive outcome should encourage deeper level of participation and extended commitment.

Both universities and industry can derive benefits from partnerships. For universities, these partnerships provide financial support for the educational, research, and service missions; broaden the experience of students and faculty; identify significant, interesting, and relevant problems; enhance regional economic development; and increase employment opportunities for students. For industry, such partnerships provide access to expertise they did not have; aid in the renewal and expansion of technology; improve access to students as potential employees; expand precompetitive research; and leverage internal research capabilities. (Prigge, G.Wand and Toraco R.K, 2008).

These partnerships, however, are not without risks. Conflicts of interest between university and industry researchers, suppression of information from fellow researchers, and “undermining of academic standards” are real possibilities and must be managed appropriately in such partnerships. A key for universities is to proactively manage university-industry partnerships and to put processes in place to minimize the risks to the greatest extent possible while maximizing the benefits.

There are many good examples of how universities and industry already do work together to deliver outstanding education and training that meet the needs of employers as well as creating graduates who are equipped for lifelong learning. For example, many institutions have introduced co-operative education programs. These come in several forms. Some provide periods of work interspersed with studies throughout the degree program, others provide final year graduates with the opportunity to work within industry on a project that the industry partner has identified.

However universities also need, as Pelikan (1992) advises, to involve industry

and the professions in the work done by universities to prepare people for roles in business and the professions.

Other forms of engagement between universities and industry include commercial research, involvement in cooperative research centers, and appointing of adjunct professors from industry to play a role in teaching. Such collaborative activities provide research students with workplace experience, an opportunity to apply theory to practice skills development opportunities in such areas as commercialization and experience in work teams (Kemp, 2000).

The main aims of this analytical study are to offer some background and examples of partnership strategies between business education and industry and to raise awareness of this issue to provide a basis for further exploration and policy as a framework for future actions across this topic.

### **Business Education and Business Community Relation**

The success of business education in today's business environment requires building and designing the curriculum that emphasizes on skills required by the workplace and the labor market. Some studies have suggested some models of participation and partnership between business schools and labor market (employers). Old models employers assumed few risks and expect few long-term benefits, while the new model of partnership reflects the engagement of employers with the business education programs, hardly more risks and making strategic investment and realizing significantly higher return on investment. (Ballen, et al, 1998).

One of the new partnership models is known as the Lansing Area Manufacturing Partnership (LAMP). This model is applied and practiced in U.S.A. to build partnerships among business, labor, education and parents. To integrate business education to labor market, there are basic techniques such as project-based learning, team-based problem solving and cooperative learning.

Macallum and Charner (2002) examined LAMP model using a case study methodology. The study identified specific and unique benefits valued by the respective partners. LAMP has broadened the awareness of manufacturing careers among education and staff by adopting contemporary language and highlighting the cutting edge nature of modern manufacturing for students and staff. Also school staff gained a greater understanding of the workplaces.

The attitudinal and behavioral changes are among the best results of applying LAMP models; therefore the workforce becomes more aware of and sensitive to a modern view of their industry

The partnership between labor market and business education can contribute to benefit both business schools and labor market. Business school gains a power tools in restructuring education according to the need of workforce and the industry will have the opportunity to add value of its operational system by recruiting competent graduates who have built their capabilities according to the cooperative system. (Wilson, Pirrie and McFall, 1996).

In establishing up an effective partnership between labor market and business schools, it is important to create a learning lab where new ideas and approaches to education can be developed and tested. Integrated curriculum and innovative instructional strategies and specifically the curriculum project-based nature can be applied to build the bridge between labor market and business school programs. These strategies develop problem-solving skills and expand the awareness of the students to their future work requirements. The non-traditional role of business school administration (Dean, HoD and Faculty members) is to participate in career development, planning and guidance into higher level of education to fill the gap between ERP (Enterprise Resource Planning Systems) job skills and ERP implementation success factors.

Various studies have attempted to define the educational outcomes that are likely to be most important for imparting ERP graduates with the skills required for successfully working with ERPs. Boyle & Strong (2006) synthesized many of the prior studies along with a survey-based research to categorize the key skills required by ERP graduates into five main categories:

1. ERP technical knowledge
2. Technical management knowledge
3. Business functional Knowledge
4. Interpersonal skills
5. Team Skills.

The integration idea of a common body of courses seems to have taken a firm root within the academic as well as professional business community.

In recent years, the American Assembly of Collegiate Schools of Business (AACSB) has promoted such a change in direction to survive and cope with labor market by adjusting business programs to the need of labour market.

Actual business environment should be simulated in the educational material for business students to present the most relevant setup. Braun (2004) suggests that

critical thinking must be incorporated into the business education curricula as it is demanded by the business world.

Reuben and Festervand (2005) observe that MBA programs have become high tech intensive and for-profit. The main issue in this trend is the idea that the business students should learn the management in a team-based environment, not in the traditional textbook way to be aligned with the needs of industry.

The active interaction between B-Schools and industry is an important power engine for innovation and economic growth. The best example for this can be drawn from the experiences of silicon valleys in the US and Europe. A dense rich history of long running collaborations in these countries has given rise to new technologies at a breakneck pace and modernizing the role of several universities. The critical indicators of the level of industry interface are the number of joint research projects taken up with industry, the number of field cases authored by faculty, the number of live cases that students take up with industry, the number of open management development programmes (MDPs) conducted, the number of consulting projects taken up by faculty and the revenue generated from them, and the frequency of revamping the curriculum and its relevance.

There are several pathways for achieving effective partnerships in terms of Business Schools solving problems of business and enhancing production methods. Similarly Business Schools can undertake practical researches and shape the curriculums that are as required by the labour market and the demands of the industries.

Besides summer internship as usual practice, students should also take up live cases with industry under the guidance of faculty.

Good interface with industry ensures that faculty members are keeping pace with the fast changing scenario of industry which is mirrored in the knowledge and skills of students who don't need much training on being hired.

### **Suggested Model of Partnership between Labor Market and Business School**

The suggested model is based on the following stages:

1. Establishing and measuring the competencies required by business departments and schools.
2. Designing an integrated context business curriculum.
3. Setting partnership system and procedures.

## Competency Measurement

The first step toward developing a conceptual and applicable model of partnership between labor market and business schools is establishing and measuring competencies of business schools graduates. The data on competencies can be used to maintain or improve the quality of higher education in general and business education programs in particular. This stage will help in aligning it with the need of the labor market.

The same data can also be used to evaluate the effects of changes in business education programs and provide greater insight into how the labor market works. A central issue hereby is to what extent business curricula succeed in providing the graduates with the qualifications needed to make any start in the labor market.

The main function of business education is to prepare people to play a role in society in general and in the labor market in particular. Much attention has been paid to determining the external returns to various programs of business education. There are various theories about the graduate labor market works and about the role of business education hereby. This makes it difficult to determine to what extent various indicators of external returns to business education – such as the chance of finding work, the match between specialization work and income which reflects the quality of the programs and graduates.

According to the human capital theory, personal characteristics such as talent, education and experience determine how well a person performs and thereby that person's productive value in the labor market and the load of the salary. In the literature regardless of how the relationship between business education and the labor market success in the short term is interpreted, Collins, 1979 refers to the importance of the dynamic nature of labor market careers in assessing educational quality. A good business program has to prepare graduates for a high level of performance on entry to the longer term too. Competencies have become so important in recent years to achieve the above mentioned objectives.

Nordhaug (1993) distinguished between three types of competencies that are specific to firms (firm-specificity), tasks (task specificity) and economic sectors (industry specificity). The match between education and work can be improved by aligning courses perfectly with these competencies of the labor market. The alignment of courses with the labor market requirements can be developed jointly by both business school and labor markets after the various competencies are established by both parties. A simplified example of job requirements matrix (competencies) that can be utilized to developing the quality of business education is illustrated in the following figure.

Figure (1)  
Competencies Matrix

Context –neutral action competencies	Solving problems	Decision making	Communication	Leadership	Dealing with Clients	Learning
Knowledge of own field or discipline						
Ability to apply field specific knowledge						
Ability to use information technology						
Ability to communicate in foreign language						
Ability to note problems and opportunities						
Ability to draw connections						
Ability to distinguish major priorities						
Ability to take decisive action						
Ability to make one's meaning clear to others						
Ability to mobilize the capacity of others						
Willingness to question one's own and others ideas						

*Resource: University of Maastricht, The Netherlands, Research centre for Education and the Labor Market (2003).*

The matrix illustrates the manner to deal with field-specific competencies. By using context-neutral formulations such as knowledge of own field and ability to apply field-specific knowledge, these items become meaningful for all categories of graduates, and the degree to which field-specific competencies are developed can be compared across diverse fields of study.

## **Designing an Integrated Business Curriculum Context**

The integration idea of a common body of courses is important for both business community and professional academics.

According to McCarthy and McCarthy (2006) the actual business environment should be simulated in the educational material for business students. For business students, actual business environment presents the most relevant setup that gives the students opportunity to practice their knowledge appropriately.

Braun (2004) suggests that critical thinking must be incorporated into the business education curricula as it is demanded by the business world. Establishing critical thinking can be achieved by applying the teaching strategies that consider the requirements of labour market. Such strategies are cooperative learning, field study and case study to link the theoretical background with the situational problems. The cultural and personnel skills are the crucial aspects in the current labour market requirements.

The cultural models were adopted in business classes to encompass all the socio-cultural skills and to provide rationale that facilitates student understanding of cultural differences, and their ability to learn about themselves and others who were not indigenous to their own culture.

Upon the above mentioned ideas, the urgent issues that have to be considered are analyzing and devising effective methods for instruction to employ in educating business students. Many studies concentrate on devising methods in business schools to improve the managerial skills of the graduates by adapting a system that has cross-functional integration of interdisciplinary and team-based approaches to business problems. (Miller, 2000)

The critical point which is almost common to all models is the idea that the business students should learn the management in a team-based environment, not in the traditional textbook method.

According to Mintzbery (1987) most companies are dissatisfied with the education and research coming out of business programs, thus a growing number of

companies prefers in-house trained employees. This may bring substantive costs on companies to bear. Also as Mintzbery (1987) points out, the graduates of business schools are parachuted into mid-level companies with authority over people who have vast knowledge in business and customer relations and thus creating two tier employees, a boss with education, but not enough knowledge on one side and employee who knows the customer, market conditions and business environment on the other. Therefore, traditional teaching methods of business courses can be dropped and replaced by the innovative business education methods, which are mostly integrative in nature.

The main suggested procedures to apply and utilize of the so called integrated business curriculum are:

### 1. Improving Business Education Programs.

A faculty team in business school and business sector representatives (some leading companies) jointly evaluate and improve the curriculum by emphasizing on the labor market development and requirements. A solid partnership in this manner means that business schools, in achieving their own education objectives and mission would be informed and attuned to what potential employers want their new employees to know.

Business schools and their students might find their programs vital and stronger when they establish a partnership to foster more interaction between students and the business world and its leaders.

A significant number of leaders from business and industry can participate in executive education programs to offer extraordinary opportunities for business faculty in high level dialogue. Business education, as noted, is designed to support large organizational needs – not those of emerging markets. The nature and self-defined missions of modern business education discourages holistic integration of business and more general living skills. They assume a general understanding of underlying morals and culture. Programs are designed to deliver business skills at the expense of all others.

### 2. Targeting and teaching the right skills

Partnership between business leaders and business education stresses understanding the essential competencies and skills sets of business school graduation, forecasting how these competencies will change in the future, and assessing the level of mastery of those skills and competencies. Business school deans acknowledge the critical role that business can play in providing quality feedback on graduate

performance and incorporate this feedback into their assessment efforts and making changes in the curriculum and programs with the business leader's engagement and discussions.

### 3. Encouraging and motivating Business School Research

An enhanced partnership between business sectors and business education would provide opportunities for the business community to gain a clearer understanding of business education research. (AACSB International, 2006)

Business sectors can assist the business schools in concentrating on the topics most relevant for business. Industry leaders could better understand the trade-offs and value of different research outputs, and researchers could understand the needs of business. Quelch, (2005) argues that business school professors pursuing academically rigorous research must be more visible within the business community. The efforts of collaboration and integration between business community and business schools could be achieved by establishing research committee to include business representatives who are qualified in the area of study such as marketing, and who have the ability to communicate their ideas of labor market research and development needs.

The other method in building an effective research program is to give business school students and professors the opportunity to work on some business problems raised by business community and provide the relevant and accurate data, information and guidance to facilitate solving these problems.

### **Partnership system and procedures**

A dynamic relationship between business leaders and business education depends on two factors. The first factor is business leader acknowledgement of the value of quality business education and the concept that industry success is tied to business school success.

The second factor is the business leaders' expectation of the outcome of their involvement in business schools and what values will be added to their own organizations.

Partnership between business leaders and business education can be achieved effectively by developing mechanism to enhance the business leaders' engagements in activities that influence the process of business schools. Universities have sought support of industry through scholarships, awards and sponsorships. Such support encourages a relationship which offers a balance of obligation and benefits, and is

a vital enabler of business interests, as well as nurturing the engine room for future talent and ideas.

Specific actions could be considered to build strong relationship and more effective partnership. Such actions are:

1. Strengthen advocacy efforts aimed at helping both communities to understand the value of an enhanced partnership between business school management and industry.
2. Establish a permanent structure which might be a workforce committee from both business leaders and business educators. The workforce committee holds the responsibility of developing the curriculum and programs, and makes the decision concerning the skills and competencies required and implements the changes through direct communication and discussion the issues.
3. Advisory board also can be suggested to be composed of business leaders and business educators. This board can be established to have a vital role in developing and changing the programs and the teaching and learning process relevant to the need of labor market.
4. Increase opportunities for engagement of senior business leaders in the current activities of business schools such as conferences, workshops, graduation ceremonies, exhibitions and so on.
5. Business Education institutes and Industry cooperation has to be embedded in institutional strategies; leadership and effective management of human resources.
6. The colleges and universities may establish a knowledge transfer office to facilitate cooperation with the industry. Knowledge transfer between universities and enterprises will work best if there is a general framework of cooperation and mutual understanding.

## CONCLUSIONS

The following conclusions can be dictated from this study

1. Industry-business school interaction sets the momentum for engaging into partnerships to map out strategies and initiate an integrated approach to business education and training for socio-economic development.
2. The shift from labor-intensive to knowledge-based economy reinforces the academic component that needs to be considered and implemented by industries, while industrial processes, skills requirements need to be well-accounted for in

educational planning and implementation.

- 3 The stronger involvement of industry in business college's boards, research agendas, admission panels, curriculum design, course delivery and QA systems improves business school teaching, research and innovation.
- 4 Industry-business school engagement is one of important strategy to develop both the academic institutions and the labor market. Students will acquire clear ideas about the work place and the labor market requirements. This enables them shape their career opportunities. Industry also benefits from such partnership in applying the updated knowledge and theories that have been considered in business education programmes.
- 5 Key indicator of successful partnership is the ability to draw interest and support from a variety of stakeholders, thereby creating a combined impact that no single partner could achieve by itself. Through the motivation or pull of productive employment and opportunity, industry complements higher education's efforts to advance or push students toward educational attainment.

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## **SIGNIFICANT DETERMINANTS OF ICT ADOPTION FOR HIGHER EDUCATION FACULTY IN THE ARABIC CULTURE: THE CASE OF SULTAN QABOOS UNIVERSITY, OMAN**

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### **ABSTRACT**

This study employs Rogers' diffusion of innovation (DoI) theory as its theoretical framework to investigate the salient factors influencing ICT adoption in the Omani cultural context. Three hundred faculty members from Sultan Qaboos University in Oman participated in the study. A hierarchical regression approach was used to examine the contributions of four blocks of predictors on ICT use: (a) adopter category; (2) ICT attributes; (c) individual-level variables including gender, age, academic rank, teaching experience, ICT experience, and ownerships of notebook and mobile phone computers; and (d) job-related factors in terms of the numbers of traditional and blended classes currently teaching. The results showed that adopter category alone significantly predicted 8% of the variance of ICT use. Perceptions of ICT attributes accounted for another 11% of the variance. However, the seven demographic and professional variables only explained additional 5% of the variance. Finally, the two job-related variables contributed another 11% to the variance of ICT adoption. In the final 11-predictor model, the four most significant factors, in the order of importance from high to low, were ICT attributes, number of traditional classes teaching in the negative direction, adopter category, and number of blended classes currently teaching. These findings indicate that Rogers' DoI theory is generally supported, but needs to be refined and modified for ICT adoption in the Omani higher education context. Theoretical and practical implications of the findings were discussed.

## 1. INTRODUCTION

Informational and communication technologies (ICT, henceforth) have gradually become an integrated part of the higher education system worldwide (Selwyn, 2007; Salleh, Jack, Bohari, & Jusoff, 2011), as well as in the Arabic counties including Oman in the past few decades (Al-Fadhli, 2009; Al Musawi, 2007). With the nation's effort to build a digital society for Oman (Omani Ministry of Information, 2006), ICT have played an even more important role than ever before in Oman higher education to support teaching, learning, and research activities. In fact, the growth of ICT in Oman has been impressive in the past decade. Faculty members have adopted ICT into their instructional and research processes more and more. Nevertheless, the status of ICT utilization in Omani higher education is still unsatisfactory (Al Musawi, 2010). Moreover, empirical evidences on ICT adoption in the Omani faculty members are still limited. Particularly, little is known about the significant factors impacting Omani faculty' ICT adoption.

More importantly, studies have found that ICT adoption varies by personal, organizational, contextual, and cultural variables (Hall, 2010; Sanchez-Franco, Martinez-Lopez, & Martin-Velicia, 2009; Straub, 2009), or even by subcultures within a higher education institution (Lin & Ha, 2009). In understanding the complex and dynamic processes of ICT adoption, many theoretical models have been proposed. Rogers' Diffusion of Innovation (DoI, thereafter) framework (Rogers, 2003) has been an influential one. However, this theory has not been extensively tested in the Arabic culture. Hence, research into significant factors influencing faculty's ICT adoption, guided by the DoI model, in the Omani culture is needed.

## 2. LITERATURE REVIEW

### 2.1. Rogers' Diffusion of Innovation Theory

Rogers' DoI theory originated from the studies of agricultural innovations in the late 1950s. It has become a general model of the diffusion of innovations for a variety of fields including education over the past six decades (Roger, 2004; Sahin, 2006). The key concept of the DoI theory is diffusion. Rogers defined it as "the process by which an innovation is communicated through certain channels over time among the members of a social system" (Rogers, 2003, p. 5). The DoI theory has many theoretical conceptualizations. But, it can be roughly dissected into four major components: adopter categories, diffusion process, perceived attributes, and rate of adoption.

First of all, members of a population vary greatly in their willingness to adopt a particular innovation. Individual characteristics such as socioeconomic features, per-

sonality traits, and communication behavior patterns can be used to divide the population into five categories: innovators, early adopters, early majority, late majority, and laggards. The frequencies of these five types of adopters closely form a normal distribution on the basis of the relative time at which an innovation is adopted as in Figure 1. Innovators are active information seekers about new ideas. Early adopters are usually not too far ahead of the average individual in innovativeness. They often serve as a role model for many other members in the system. The early majority adopt innovations just before the average number of a social system. The late majority are skeptical to new ideas. They adopt innovations just after the average number of the system. Laggards are the last group in the system to adopt an innovation. They tend to be suspicious of innovation or even resistant to innovation.

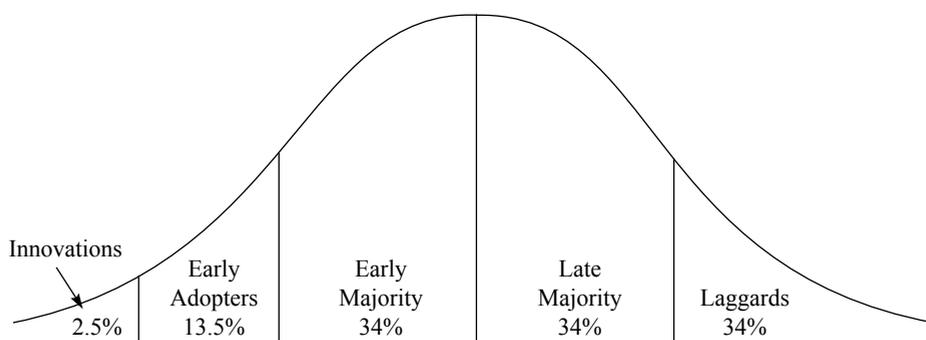


Figure 1. Adopter Categorization on the Basis of Innovativeness  
(Adapted from: Rogers, 2003. p.281).

Secondly, diffusion is a process of five distinct stages that occurs over time as shown in Figure 2. In the knowledge process, an individual is exposed to the existence of an innovation and gains an understanding of how it works. Three broad categories of personal characteristics: socioeconomic characteristics, personality traits, and communication behaviors, affect the extent to which the person possesses knowledge about the innovation. The next process, persuasion, occurs when an individual forms an attitude towards the innovation. The personal perception on the five attributes of an innovation plays a vital role in forming the favorable or unfavorable attitude towards innovation. In the decision process, the individual has decided to either adopt or reject the innovation and engaged in activities associated with the choice. In the implementation process, the individual puts the new idea or innovation into use, if deciding to adopt the innovation. In the final process, confirmation, an individual seeks reinforcement or revision of the decision being made. If the previous

decision of adoption or rejection seems to be correct, the individual keeps the same choice. Otherwise, the person reverses the previous decision.

#### PRIOR CONDITIONS

1. Previous practice
2. Felt needs/problems
3. Innovativeness
4. Norms of the social systems

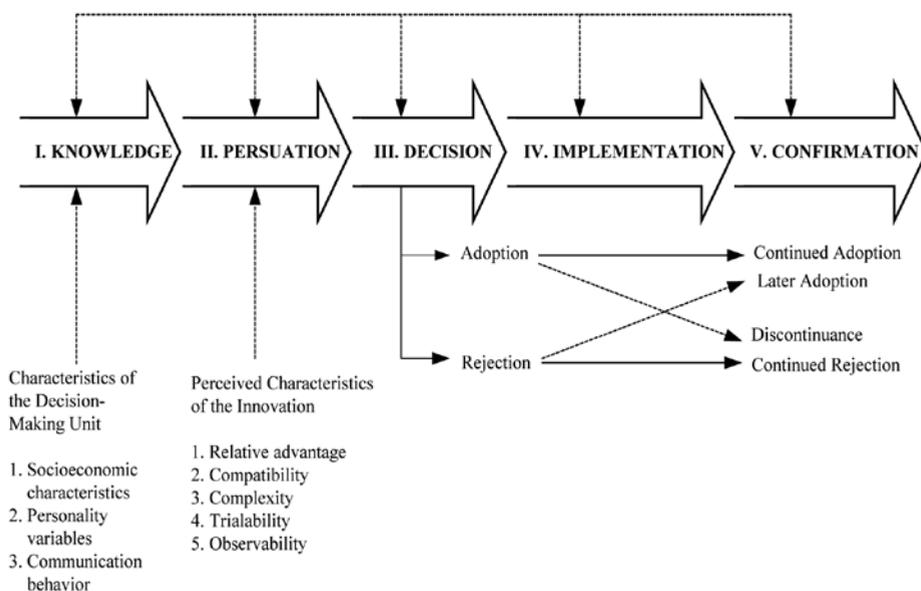


Figure 2. A model of five stages in the innovation-decision process  
(Adapted from: Rogers, 2003, p. 170).

Thirdly, a person's perception of an innovation influences the adoption decision. Five perceived attributes of an innovation have been shown to have strong influence: trialability - the degree to which potential adopters can experiment with the new behavior, observability - the degree to which the results of an innovation are visible to others, relative advantage - the degree to which a new system is perceived as being better than the alternative it supersedes, complexity - the degree to which an innovation is perceived as difficult to understand and use, and compatibility - the similarity with previously adopted innovations.

Finally, the rate of adoption—the relative speed with which members of a social system adopt an innovation, is affected by five broad categories of variables as in Figure 3: perceived attributes of an innovation, type of innovation-decision, communication channels, nature of the social system, and the extent of the changing agent's promotion effort. Rogers (2003) stated that among the five categories of

variables, the perceived attributes of innovation have been the most extensively studied. The type of innovation-decision affects the rate of adoption in the sense that the greater the number of individuals involved in the decision process, the slower the rate of adoption. Communication channels in the form of mass media make the rate of adoption faster than the means of interpersonal channels which often happen for later adopters. If a social system is highly structured, interconnected, and organized, the adoption rate of innovation is usually fast. Lastly, the more promotion effort on innovation the change agent spends, the faster the rate of adoption. Rogers further concluded that about 49-87% of the variance in the rate of adoption can be explained by these five categories of variables. Moreover, he claimed that the attributes of innovations alone could explain approximately half of the variance in rate of adoption.

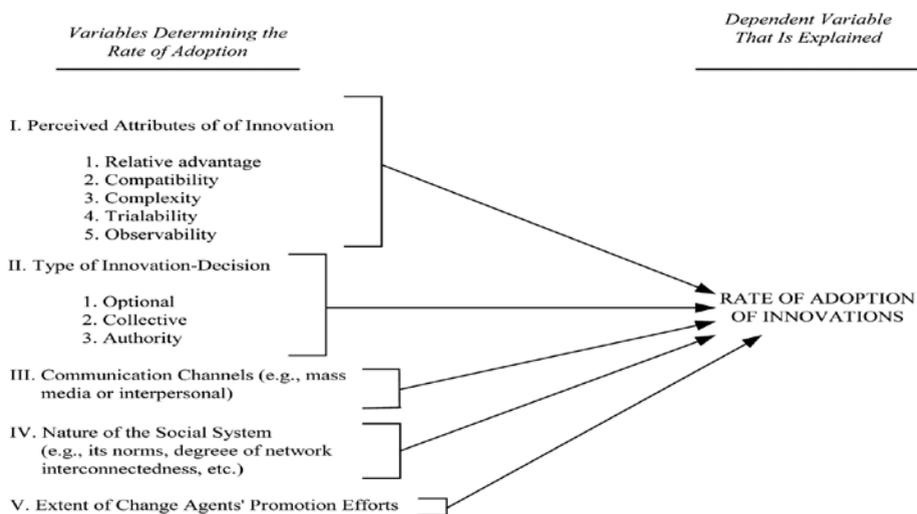


Figure 3. Variables determining the rate of adoption of innovations  
(Adapted from: Rogers, 2003, p.222).

## 2.2. Studies on ICT Adoptions based on Rogers' DoI Framework

Numerous studies have used Rogers' DoI theory to explain ICT adoption or ICT diffusion in higher education. Some have particularly focused on the concept of adopter categories and the difference on ICT adoption between early and late adopters (e.g., Keese & Shepard, 2011; Loogma, Kruusvall, & Umarik, 2012; Zayim, Yildirim, & Saka, 2006). The findings have typically supported Rogers' general claim of significant differences between the early adopters and the mainstream faculty on ICT adoption.

Others have used the five stages of the innovation-decision process as a concep-

tual framework to explain ICT adoption in teaching and learning. For instance, Beck and Black (2012) examined the role of communications in each of the five stages, and identified several problematic communication strategies including overstating communications, negative evaluations, and ineffective communication with stakeholders. Li and Lindner (2007) employed Rogers' model of the innovation-decision process to determine the Chinese faculty's adoption behavior about web-based distance education. They reported that about 70% of the 273 participants were in early stages of no knowledge, knowledge, or persuasion in the innovation-decision process, and the remaining 30% were in later stages of decision, implementation, or confirmation. Moreover, they found that faculty members' stage in the process differed significantly by their professional area, level of education, teaching experience and distance education experience. However, gender, age and academic rank had no significant influence. Alhawiti (2011) also found a significant relationship between faculty's web-based distance education experience and their stage in the innovation-decision process at two Saudi universities.

As Rogers observed, there is rich literature on perceived attributes of innovation. However, although researchers generally agree upon on the significance of attributes of innovation on ICT adoption, they differ greatly on the number of attributes and the relative importance of each individual attribute. Rogers (2003) himself stated that, among the five innovation attributes, relative advantage and compatibility are particularly important in explaining the rate of adoption. However, Surry and Gustafson (1994) found that complexity was also an important factor when introducing an innovation into instructional settings. Gibson, Harris, and Colaric (2008) reported that perceived usefulness or relative advantage is a strong indicator of faculty's acceptance on online education technology, whereas perceived ease of use or complexity offers little additional predictive power.

Based on a meta-analysis of 105 publications on diffusion of innovation in a variety of fields, Tornatzky and Klein (1982) identified ten most frequently used attributes of innovation: compatibility, relative advantage, complexity, cost, communicability, divisibility, profitability, social approval, trialability, and observability. They further stated that compatibility, relative advantage, and complexity are the most important innovation characteristics related to innovation adoption. Moore and Benbasat (1991) further developed a survey based on Tornatzky and Klein's work. Nevertheless, the factor analysis on a sample of 540 participants suggested an eight-factor structure. In addition to the five attributes by Rogers, voluntariness, image, and demonstrability were identified.

The most intricate and comprehensive component in Roger's DoI theory probably is the prediction model of the adoption rate of innovation by the five categories of variables, as shown in Figure 3. Although this model appears to be very descriptive, it is extremely challenging to be empirically validated due to its complexity. In fact, no studies have been found to examine the full-fledged model. Instead, educational researchers have often altered the prediction model to some extent on both the dependent and predictor variables. For the dependent variable, ICT adoption or ICT use has often been used to replace the rate of adoption. In other words, adopter category in many cases is no longer the dependent variable as in Rogers (2003) anymore. For the predictor variables, investigators typically drop the macro-level variables from the original model, but include other more easily measurable micro-level variables.

### **2.3. Higher Education in Oman and ICT in the Omani context**

The Sultanate of Oman is located in the Southeast of the Arabian Peninsula. Higher education in Oman is relatively new. However, since Oman's first university, SQU, was opened in 1986, the growth of higher education in Oman has been rapid in the past three decades, especially in the private sector. While SQU remains as the nation's sole public university with approximately 17,000 students in the academic year 2009-2010, there were 27 private universities and colleges in with an enrollment of some 35,000 students in Oman's system of higher education in 2011 (Omani Ministry of Higher Education, 2011).

Along with the steady development of higher education system, e-learning has grown rapidly as well in Omani higher education although it is still in its childhood (Al Musawi & Abdelraheem, 2004). The number of online courses available and the number of users involved have dramatically increased, most notably at SQU. Moreover, to be aligned with the e-government initiative, the Omani Ministry of Education (2008) has strategically planned the nation's technology-oriented infrastructure of educational system in two contexts: a virtual classroom system and a self-learning system. However, the advocacy of ICT at the national policy level and the growing power of ICT do not mean that ICT have been automatically transformed into the instructional processes. There is still a long way to go for Omani educators to get engaged in a fully-fledged e-learning system in a country where the primary delivery model of education has been essentially traditional.

Many studies have been conducted to understand ICT integration into Omani higher education. These studies roughly fall into in three categories: (a) institutional strategic implementation of the e-learning system; (b) the relationship between fac-

ulty members and various aspects of ICT including adoption, attitudes, perception, concerns, and impact of e-learning on their instructional practices, and (c) the impact of e-learning on students. The present study fell into the second category. However, it distinguished itself from the earlier ones in that it used Rogers' DoI model as its theoretical foundation, and employed the multivariate approach to investigate the relative and combined contribution of many factors to ICT adoption.

## 2.4. Studies on Prediction of ICT Adoption

The first cluster of studies on prediction of ICT adoption based on Rogers' DoI theory mainly concentrates on attributes of innovations. For instance, Al-Fulih (2003) used the eight attributes in Moore and Benbasat (1991) (i.e., relative advantage, image, compatibility, ease of use, result demonstrability, visibility, trialability, and voluntariness) to predict the Internet use for instructional purposes in 453 Saudi faculty members. Results showed that approximately 40% of variation on Internet adoption could be explained by these eight variables, but only relative advantage, image, compatibility, ease of use, and visibility were significant predictors in the presence of other predictors. In a different study using the Saudi Arabian faculty sample, Almobarraz (2007) employed the simultaneous multiple regression model to predict the Internet adoption in 344 faculty members from Imam Mohammed Bin Saud University. The results showed that the same eight attributes could collectively explain 33.4% of the variance on Internet adoption. However, in another study on the use of the Internet as an instructional tool in Brazil, Martins, Steil, and Todesco (2004) reported the two most significant predictors were trialability and observability.

Using the technique of structural equation modeling, Usluel, Aşkar, and Baş (2008) investigated the impacts of both ICT attributes (i.e., relative advantage, compatibility, ease of use, and observability) and ICT facilities (i.e., in classroom, in lab, and in office) on ICT instructional and managerial uses in 834 faculty members from 22 universities in Turkey. The findings indicated that about 61% of variance on ICT use could be explained by ICT facilities and ICT attributes. But ICT facilities ( $\beta = .73, t = 11.46., p < .05$ ) contributed much more than ICT attributes, although the direct path between ICT attributes and ICT use was statistically significant ( $\beta = .19, t = 4.01., p < .05$ ) as well.

The second chunk of studies, guided by Rogers' DoI theory, used adopter categories, attributes of innovation, and other individual and organizational variables to predict ICT adoption. For example, Alnujaidi (2008) investigated the factors that influence the adoption and integration of Web-Based Instruction (WBI) by English

language faculty members in Saudi Arabia. The selected predictors were Rogers' five attributes of innovation (relative advantage, compatibility, complexity, trialability, and observability), the ISTE National Educational Technology Standards for Teachers (NETST), and seven demographic variables (gender, age, academic rank, nationality, major, country of graduation, and years of teaching experience). Results indicated that the five attributes, the NETST standards, and three demographic variables (academic rank, major, and country of graduation) were the significant predictors.

Similarly, Sahin and Thompson (2006) used the DoI theory as the theoretical framework in instrument development, data collection, and interpretation of the results to explore instructional computer use in a sample of 117 faculty members in the College of Education in Turkey. Results from the study showed that computer expertise, computer access, barriers to computer access, attitude toward computer use, support for computer use, and adopter categories significantly correlated with faculty members' level of computer use.

Park (2005) used structural equation modeling to predict the level of web-assisted instruction use by personal characteristics, attributes of innovation, and perception of influence and support from the environment in a sample of 197 faculty members in a large southeastern university in the United States in 2003. The results showed that computer experience, subjective norm, self-efficacy, relative advantage, and complexity were the most important predictors. Furthermore, relative advantage and subjective norm had a direct effect on level of ICT use.

As it is not practical to include a broader array of factors, this study particularly focused on 11 variables and arranged them in four blocks: (a) adopter category; (b) perception of ICT attributes; (c) personal-level variables including gender, age, academic rank, teaching experience in higher education, experience using computers, ownerships of a laptop computer and a mobile phone computer; and (d) job-related variables including numbers of traditional and blended classes currently teaching. The concepts of adopter category and attributes of innovation are directly from Rogers. They have been extensively studied.

Of the seven individual-level variables, gender and age are the basic demographic characteristics. Academic rank, teaching experience in higher education, and experience with computers served as the profession-level factors. These five variables have also appeared as predictors of faculty members' ICT adoption (e.g., Al Musawi & Abdelraheem, 2004; Cardwell-Hampton, 2009). The other two variables are technological device-related. Comparatively, the importance of laptop computers

has gradually been recognized (e.g., Aoki, 2010; McCarty, 2002; Zawacki-Richter, Brown, & Delport, 2009). However, the newest technology - mobile phone computer has not caught sufficient attention as a catalyst of faculty's ICT adoption in higher education.

Finally, the two job-related variables, the numbers of traditional and blended classes currently teaching, were selected as they appeared to be pertaining to the context of the SQU teachers' working environment. Over half of the faculty members taught traditional classes only at the time of the investigation. The rest had blended classes. Blended teaching, as an integration of traditional face-to-face and online approaches to instruction (George-Walker & Keeffe, 2010), has been the sole form of e-learning at SQU since 1991.

## **2.5. Research Questions**

This study was designed to explore the 11 chosen factors impacting faculty's ICT adoption in the Omani cultural context using the multivariate approach. The main research questions were:

1. What is the current status of ICT adoption or ICT use in the SQU faculty?
2. What is the distribution pattern of the SQU faculty members from the perspective of Roger's categories of adopters?
3. How do the SQU instructors perceive the ICT attributes?
4. How do the four blocks of variables predict ICT use?
5. Which predictors are the salient ones?

## **3. METHODOLOGY**

### **3.1. Research Participants**

The survey was distributed to all of the 430 Omani faculty members in all of the nine colleges at SQU in January, 2009. Three hundred and two returned the survey, at a response rate of 70%. Two of them had unusable data. The final sample of 300 Omani faculty members consisted of 181 males. Over 87% of the participants were junior faculty members including 149 assistant professors and 113 lectures, 10% higher than the junior faculty pool at the university. Approximately three-fourths of the participants were under age 40. All of these faculty members had an office computer, and over 95% of them had a home computer. These two homogenous variables were excluded from further consideration. Almost 78% of the participants

owned a laptop computer, and over one-third of the participants owned the newest technology device.

*Table 1*  
*Categorical Personal-Level Information of the Participants*

Variables	Frequency	Percentage
Gender		
male	181	60.3
female	119	39.7
Age group		
20-29	89	29.7
30-39	134	44.7
40-49	61	20.3
50-59	16	5.3
Academic rank		
lecturer/instructor	113	37.7
assistant professor	149	49.7
associate professor	29	9.7
professor	9	3.0
Own a laptop		
yes	233	77.7
no	67	22.3
Own a mobile phone computer		
yes	107	35.7
no	193	64.3

Table 2 displays the four continuous predictor variables for the present study. Teaching experience in the participants ranged from none to 25 years with an average value of 7.6 years. Experience of using computers ranged between 3 and 26 years with a mean value of 11.06. Thus, the participants seemed to be a representation of the mainstream faculty at SQU, with a medium level of teaching and computer experience. For the current workload in term of the number of classes teaching, these faculty members, on average, taught approximately two traditional classes and one online class. Thus, the traditional face-to-face teaching appeared to be still the dominant delivery form of instructions at SQU.

*Table 2*  
*Continuous Personal-Level and Job-Related Variables of the Participants*

<b>Variables</b>	<b>Min</b>	<b>Max</b>	<b>M</b>	<b>SD</b>
Teaching experiences in higher education in years	0	25	7.60	4.93
Experiences of using computers in years	3	26	11.06	3.83
Number of traditional classes teaching currently	0	6	1.94	1.44
Number of blended courses teaching currently	0	12	.79	1.24

### 3.2. The Measurement Instrument and Variables

The survey, based on the benchmarks from similar studies conducted in the West, consists of four parts. In Part 1, the faculty members were asked to rate themselves on the current level of ICT use on 18 items. These items, with some modifications, were based on others' instruments devised for a similar task (e.g., Isleem, 2003; Sahin & Thompson, 2006). These items were expected to cover a broad range of possible applications of ICT in today's educational environment at SQU. Each item had five rating points: 1 = *Never*, 2 = *Rarely*, 3 = *Sometimes*, 4 = *Often*, and 5 = *Very Often*. The scale-level mean across the 18 items, was used as the quantitative index of ICT adoption or ICT use. It served as the dependent variable in the multiple regression analysis.

Part two was designed to classify faculty members into Rogers' five categories of adopters. It contains only one item with six possible choices. The first four options correspond to innovator, early adopter, early majority, and late majority in Rogers (2003). The last two options fall into the category of laggards. Although it may be desirable to use multiple items to categorize faculty members, such a survey was not obtained. Thus, this study, like others (e.g., Sahin & Thompson, 2006), used one comprehensive statement to differentiate the faculty members on the temporal sequence of ICT adoption in relative to their colleagues. This categorical variable was used as a predictor in the regression analysis.

The third part focused on faculty members' perceptions of ICT attributes. These items were mainly from Moore and Benbasat (1991). However, the eight-factor structure of the 39-item survey in the American culture turned out to be non-admissible after 50 iterations in the present sample. In other words, the original factorial structure from the Western culture was not supported in the Omani culture. Sub-

sequently, this study conducted an exploratory factor analysis (EFA) to seek the new clusters of ICT attributes in the Omani cultural context. Before the EFA, two items were dropped from the original survey as they were considered as culturally insensitive by a panel of experts: (a) my using personal work station requires a lot of mental work, and (b) personal work station was available to me to adequately test run various applications. Conversely, thirteen items excluded in the testing process by Moore and Benbasat were added back. These resulted in 50 items subject to the EFA. Lastly, the original wording of PWS (personal work station) was substituted by computing technology. The scale mean was used as a predictor variable as well.

The last part was designed to collect the personal and job-related information. The seven personal-level variables and two job-related variables selected were also used as predictors in the regression analysis.

In summary, the survey used for the present study consisted of four parts. The first section included 18 items on the perceived level of ICT use. The second part had one item on adopter category. The third one included 50 items on perception of ICT attributes. And the last part had seven items on individual-level data and two items on job-related workload. The survey showed a satisfactory facial validity by a panel of eight American and Arabic experts. The survey was also pilot-tested with ten faculty members at SQU.

### **3.3. Data Analysis Strategies**

The present study employs multiple regression, a versatile multivariate statistic technique, to investigate the relationship between the dependent variable (i.e., the level of ICT adoption), and a set of categorical and continuous predictor variables. For the categorical predictors, the technique of criterion coding, instead of dummy coding, was used. In other words, the dependent variable mean of each group of a categorical predictor was used to replace the original nominal value. This coding technique allows “the use of a single vector to represent all categories of the nominal independent variable (instead of multiple dummy coded variables) and the simultaneous use of such vectors with other criterion coded variables in the same regression analysis” (Henson & Hwang, 2002, p. 717).

Hair, Black, Babin, and Anderson (2009) stated that there are four primary assumptions for a multiple regression: (a) linearity of relationship between the predictors and the criterion variable, (b) constant variance of the errors (i.e., homoscedasticity), (c) independence of error terms (i.e., each predicted value is independent of other predicted values), and (d) normality of the error terms. The scrutiny of the studentized residual diagrams and the normal probability plots showed no serious

violations of the four assumptions in the current sample. Additionally, Hair et al. argued that multicollinearity among the independent variables could lead to the suppression effect. Multicollinearity is often detected by using the variance inflation factor (VIF). For the present study, a more restrictive VIF value of 1.96, corresponding to a tolerance of .51 or a multiple correlation coefficient of .70, was used as the threshold. The VIF values shown in Table 8 indicate that multicollinearity was not a threat at all. Moreover, no multivariate outliers were detected based on Mahalanobis distance. Hence, the assumptions of the multivariate regression analysis were considered to be met.

In extracting the factorial structures of the *Perception of ICT Attributes Scale*, the technique of exploratory factor analysis was employed. Hair et al. (2009) recommended that at least two assumptions need to be met: (a) Bartlett's test of sphericity for the correlation matrix of the items must be at least significant at least at the .05 level, and (b) the value of measure of sampling adequacy (MSA) must be greater than .50 for both the overall scale and each individual variable. In assessing factor loading, Hair et al. (2009) stated  $\pm .50$  as the minimum criterion for practical significance. These guidelines were followed in the present study. In addition, the corrected item-total correlation is an assessment of convergent construct validity at the item level. Different cutoff points have been used in the literature to retain the items, typically ranging from .30 to .50. For the present study, the cutoff point of .40 was used as in others (e.g., Gay, d'Acremont, Schmidt, & Van der Linden, 2008).

In interpreting the results of multiple regression analyses at the model level, in addition to the conventional  $F$  value and the multiple  $R^2$ , the adjusted  $R^2$  was also emphasized as it is more robust due to its adjustments to the possible model specification, sampling, and random errors. For the contribution of each individual predictor, the standardized regression coefficient (i.e.,  $\beta$ ) was used due to its comparability across the predictor variables in different units of measure. In addition, Courville and Thompson (2001) pointed out that predictors in a multiple regression are often correlated to some extent. They further proposed to use both the standardized  $\beta$  weight and the structural coefficient (i.e., the correlation between the predictor and the predicted value of the dependent variable) to judge the relative importance of each predictor variable.

## 4. RESULTS

### 4.1. Level of ICT Use

Table 3 shows the means and standard deviations of ICT use in the sample. For the Omani faculty members at SQU, the top three categories of ICT use were browsing the contents of the worldwide web, using Internet search engines, and word processing. They used these ICT functions more than once a week. The next three highly used areas were presentations, internet communication services, and spreadsheets. They used them more than once a month. The five least utilized ICT application areas were simulation and games, video/audio conferences, web design software (e.g., FrontPage, Dreamweaver), interactive communication (e.g., Skype or SMS), and Web 2.0 tools (e.g., blogs or wikis). All of them were at a level of less than once a semester. The alpha coefficient for the 18 items of ICT use was satisfactory, at .80.

*Table 3*  
*Level of ICT Use (N = 300)*

Items	Level of ICT use	
	M	SD
1. Word Processing	4.15 <sup>a</sup>	.94
2. Spreadsheets	3.34	1.16
3. Database Management	2.13	1.10
4. Graphics	2.53	1.16
5. Presentation	3.87	1.04
6. CD-ROM, DVD, Web-based Interactive Content	2.89	1.20
7. Website Design Software	1.77	1.02
8. Internet Communication Services	3.82	1.38
9. Internet Content	4.30	1.03
10. Data Analysis Software	2.44	1.31
11. Simulations and Games	1.63	.93
12. Video/Audio Conferencing	1.68	1.00
13. FTP	2.40	1.26
14. Web-based Class Management Tools	2.10	1.28
15. Interactive Communication	1.81	1.07
16. Web 2.0 Tools	1.90	1.16
17. Search Engines	4.23	1.04
18. Electronic Video	2.85	1.24

*Note:* a. 1 = Never, 2 = Rarely, 3 = Sometimes, 4 = Often, and 5 = Very Often.

Table 4 further lists the descriptive statistics on ICT use by the categorical personal-level variables. The mean for each group in the categorical variables was not only for the descriptive purpose, but also for criterion coding in the regression analysis and interpretation of the results. It should be noted that the last two groups of age and academic rank in Table 1 were collapsed into one, respectively, due to the small group sizes.

*Table 4*

*Levels of ICT Use by Categorical Personal-Level Variables (N = 300)*

Variables	ICT use	
	M	SD
Gender		
1 = male ( <i>n</i> = 181)	2.81	.58
2 = female ( <i>n</i> = 119)	2.71	.48
Age		
1 = 20–29 year old ( <i>n</i> = 89 )	2.66	.57
2 = 30–39 year old ( <i>n</i> = 134 )	2.84	.52
3 = 40–59 year old ( <i>n</i> = 77 )*	2.77	.53
Academic rank		
1 = lecturer/ instructor ( <i>n</i> = 113 )	2.67	.57
2 = assistant professor ( <i>n</i> = 149 )	2.80	.52
3 = senior professor ( <i>n</i> = 38 )*	2.92	.49
Laptop		
0 = no ( <i>n</i> = 67 )	2.72	.45
1 = yes ( <i>n</i> = 233 )	2.78	.56
Mobile phone computer		
0 = no ( <i>n</i> = 193 )	2.70	.52
1 = yes ( <i>n</i> = 107 )	2.90	.56

*Note:* \* indicates combined

## 4.2. Different Type of Adopters

Table 5 lists the numbers of faculty members in each of the five adopter categories by Rogers (2003). About one-fifth of the respondents identified themselves as

innovators, much larger than 2.5% in Rogers. The early adopters group consisted of 35.3%, also considerably greater than the corresponding 13.5% in Rogers. However, thirty-two percent for the early majority group was similar to 34% in the normal distribution. Subsequently, the last two groups in 13.7% and .7% were much smaller than the corresponding 34% and 16% in the normal distribution. Hence, different from normal distribution by Rogers, the distribution pattern of the participants appeared to be positively skewed, with more members in the early adopter categories.

To simplify this categorical predictor for the regression analysis, these five categories were further collapsed into two groups based on the data distribution in the sample: the adventuresome group consisting of innovators and early adopters, and the follower group containing the early majorities, late majorities, and laggards. Such grouping strategy appeared in other studies as well (e.g., Romano, 2012).

*Table 5*

*Number of Participants in Different Types of Adopters (N = 300)*

<b>Types</b>	<b>Frequency</b>	<b>Percentage</b>
Innovator	55	18.33
Early adopters	106	35.33
Early majority	96	32.00
Late majority	41	13.67
Laggard	2	.66

### **4.3. Perception of the ICT Attributes**

As the eight-factor structure was not confirmed in the current sample either for the 37-item or the extended 50-item survey, EFA was used to extract the factorial structure of the 50-item survey. Due to space limitation, the detailed process of EFA by using the techniques of principal component analysis with Varimax and parallel analysis was omitted. But the final result was presented in Table 6. Eventually, 12 items were found to be solidly loaded on three factors. Factor 1 had seven items. These items appeared to be either on compatibility between ICT and job tasks or between ICT and personal styles. Thus, factor 1 was named as compatibility. The three items in factor 2 were on ease use of ICT or complexity. The two items in the last factor were about the relative advantages of ICT for job efficiency. Collectively, these three factors could explain 68% of the variance of ICT attributes. The three individual factors accounted for 35%, 18%, and 16% of the variance, respectively.

*Table 6*  
*Factor Pattern for 12 Items on the Perception of ICT Attributes Scale (N = 300)*

Items	MSA	M	SD	Factors			h <sup>2</sup>
				F1	F2	F3	
Using computing technology improves my job performance.	.86	4.16	.79	<u>.81</u>	.09	.19	.71
Using computing technology enhances my effectiveness on the job.	.84	4.19	.74	<u>.83</u>	.12	.22	.76
Overall, I find using computing technology to be advantageous in my job.	.91	4.28	.78	<u>.85</u>	.23	.06	.78
Using computing technology increases my productivity.	.89	4.18	.76	<u>.62</u>	.24	.29	.52
Using computing technology is compatible with all aspects of my work.	.86	4.06	.90	<u>.62</u>	.30	.18	.51
Using computing technology is completely compatible with my current situation.	.93	4.11	.86	<u>.75</u>	.24	.06	.62
I think that using computing technology fits well with the way I like to work.	.89	4.07	.94	<u>.72</u>	.17	.08	.55
Learning to operate computing technology is easy for me.	.81	4.11	.78	.16	<u>.83</u>	.03	.71
I would have no difficulty telling others about the results of using computing technology.	.87	4.06	.75	.24	<u>.76</u>	.21	.69
I believe I could communicate to others the consequences of using computing technology.	.90	3.98	.95	.25	<u>.74</u>	.10	.62
Using computing technology enables me to accomplish tasks more quickly.	.74	4.24	.77	.19	.11	<u>.90</u>	.86
Using computing technology makes it easier to do my job.	.74	4.27	.78	.20	.15	<u>.90</u>	.87
Trace				4.15	2.16	1.89	
% Variance				35%	18%	16%	
Total % variance: 68.3%							
Mean h <sup>2</sup>							68%

*Note:* a. 5 point Likert scale with 1 = strongly disagree and 5 = strongly agree.

b. F1 = Compatibility, F2 = Ease of use, F3 = Relative advantage.

Structure coefficients greater than .50 are underlined. Percent variance is post-rotated

c. The overall KMO MSA was .86. Bartlett's Test of Sphericity:  $\chi^2(66) = 1986.44, p < .001$ .

Table 7 shows that the alpha coefficients were mostly satisfactory: .89 for the entire scale and .89, .75 and .86, respectively, for the three individual subscales. The three inter-factor correlations, from .32 to .51, were desirably moderate and significant at the .001 level. Thus, the three-factor structure of the 12-item survey was both reliable and valid in the present sample.

Table 7 also lists the means and standard deviation on the three factors and the entire scale. All of the four means were slightly over 4.0. Relatively, factor 3 on ICT advantages had higher rating than the other two factors. These means indicated that the faculty members collectively agreed the values of ICT in the three domains.

*Table 7*

*Cronbach Alpha and the Inter-factor Correlation Matrix for the ICT Attributes Scale*

	<i>M</i>	<i>SD</i>	<i>F1</i>	<i>F2</i>	<i>F3</i>
F1 (7 items, $\alpha = .89$ )	4.15 <sup>a</sup>	.65	–		
F2 (3items, $\alpha = .75$ )	4.05	.68	.51***	–	
F3 (2 items, $\alpha = .86$ )	4.26	.72	.41***	.33***	–
Scale (12 items, $\alpha = .89$ )	4.14	.55			

*Note:* a: 5 point Likert scale with 1 = strongly disagree and 5 = strongly agree.

b. \*\*\* = Significant at the .001 level.

c. F1 = Compatibility, F2 = Complexity, F3 = Relative advantage.

#### 4.4. Prediction on ICT Use

The last two research questions were to predict Omani faculty' ICT adoption and to determine the salient factors affecting ICT use. Hierarchical multiple regression was employed to investigate the relative and combined contributions of four blocks of variables: (a) adopter category, (b) ICT attributes, (c) personal characteristics, and (d) job-related factors.

Table 8 shows that the first block with the sole predictor of adopter category significantly predicted ICT use:  $F(1, 298) = 26.52, p < .001$ . The early adopters were more likely to use ICT than the late counterparts. However, the factor of adopter category explained only 8% of the variance of ICT adoption, smaller than the minimum threshold of a medium practical significance at 9% (Cohen, 1986).

When ICT attributes in the second block entered into the equation, the prediction became even more significant:  $F(2, 297) = 34.34, p < .001$ . The  $R^2$  and adjusted  $R^2$  had increased to .19, a medium effect size. In other words, the newly added predictor contributed 11% to the prediction. In this two-factor model, both adopter category and ICT attributes were significant at the .001 level. Moreover, ICT attributes appeared to be even better as it had larger standardized and structure coefficients.

After the seven personal variables in the third block were included into the equation, although still significant, the  $F$  value had dramatically dropped:  $F(9, 290) = 10.17, p < .001$ . These seven variables collectively only accounted for another 5% of the variance on ICT use. The increase of the adjusted  $R^2$  was even less, at 3%. The practical significance of this 9-factor prediction model was still moderate. For the individual predictors, both the  $\beta$  value and the structure coefficient indicated that ICT attributes and adopter category were the two top predictors. Among the seven personal-level variables, only experience with computers and ownership of a mobile phone computer demonstrated a marginal significance. The other five personal characteristics were insignificant.

Finally, two job-related variables were included into the prediction as the last block. They notably contributed additional 11% to the explanation of the variance of ICT adoption. The prediction had also been somewhat improved from the previous model:  $F(11, 288) = 13.90, p < .001$ . This entire 11-factor prediction model also demonstrated a large practical significance with a  $R^2$  value of 35% and an adjusted  $R^2$  at 32%. For the individual predictor variables, ICT attributes appeared to be the top one with the largest  $\beta$  value and structure coefficient. The number of traditional classes currently teaching was the next salient factor. The negative values of the  $\beta$  and  $r$  coefficients indicated that this variable were negatively associated with ICT use. The third critical variable was adopter category, followed by the number of blended classes currently teaching. The ownership of a mobile phone computer was significant as well. But it was much less powerful than the other four salient predictors. The remaining six personal-level variables were insignificant.

*Table 8*  
*Results of the Hierarchical Regression with Four Blocks of Variables on ICT Use*

Predictors	ICT use						Model statistics	$\Delta R^2$
	$\beta$	t	p	r	VIF			
Block 1 – Category							$F(1, 298) = 26.52^{***}$ $R^2 = .08, R_{adj}^2 = .08$	
Adopter category	.29	5.15	***	1.00***	NA			
Block 2 – ICT attributes							$F(2, 297) = 34.84^{***}$ $R^2 = .19, R_{adj}^2 = .19$	.11
Adopter category	.22	4.19	***	.66***	1.04			
ICT attributes	.34	6.30	***	.87***	1.04			
Block 3 – Personal							$F(9, 290) = 10.17^{***}$ $R^2 = .24, R_{adj}^2 = .22$	.05
Category	.22	4.00	***	.58***	1.10			
ICT attributes	.30	5.68	***	.77***	1.07			
Gender	.02	.31	>.05	.17**	1.15			
Age	.04	.62	>.05	.28***	1.29			
Rank	.09	1.49	>.05	.31***	1.30			
Teaching experience	-.07	-1.14	>.05	.24***	1.63			
ICT experience	.16	2.56	*	.38***	1.50			
Laptop	-.01	-.20	>.05	.09	1.08			
Mobile phone PC	.14	2.52	*	.37***	1.13			
Block 4 – Job-related							$F(11, 288) = 13.90^{***}$ $R^2 = .35, R_{adj}^2 = .32$	.11
Category	.24	4.51	***	.49***	1.19			
ICT attributes	.31	6.20	***	.64***	1.07			
Gender	.03	.62	>.05	.14*	1.16			
Age	-.03	-.54	>.05	.23**	1.34			
Rank	.07	1.28	>.05	.26***	1.32			
Teaching experience	-.02	-.32	>.05	.20***	1.66			
ICT experience	.06	1.02	>.05	.32***	1.65			
Laptop	.01	.15	>.05	.08	1.09			
Mobile phone PC	.13	2.57	*	.31***	1.14			
Traditional classes	-.31	-5.74	***	-.48***	1.26			
Blended classes	.14	2.87	**	.42***	1.11			

Note: \*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$ .

## 5. DISCUSSION

The present study explored a number of factors that were of importance for ICT adoption in the Omani higher education. It used Rogers' DoI framework as the theoretical foundation. It employed the hierarchical regression technique to assess the relative and combined contributions of the variables in four blocks and to identify the salient factors impacting ICT adoption.

Findings from the study first indicated that the ICT utilization in the SQU faculty overall was still low, less than once a month. This result was consistent with many other observations in the Arabic universities (e.g., Al-Qirim, 2011; Alnujaidi, 2008; Alsurori & Salim, 2010; Zare-ee, 2011). The top three areas of ICT use were browsing the contents of websites, using Internet search engines, and word processing, at a frequency of at least once a week. On the other hand, the faculty rarely used simulation and games, video/audio conferences, web design software, interactive communication, or Web 2.0 tools. Other studies also reported that word processing, emails, and web content browsing had the most popular uses, whereas multimedia and communication tools demonstrated the least frequent ICT use in faculty members in other countries (e.g., Lamboy & Bucker, 2003; Odabasi, 2000; Sahin & Thompson, 2006).

With regard to adopter category, this study found the distribution of the faculty members in the five adopter categories was positively skewed. Approximately 86% of the faculty members classified themselves as the innovators, early adopters, or early majority, rather than 50% as claimed by Rogers. Lee (2002) also reported that most faculty members were in the upper three categories (innovator, early adopter, and early majority) in 11 institutes of technology in the central region of Taiwan on faculty members' adoption of web-enhanced instructional technology. When adopter category served as the first block of variable on predicting ICT adoption, it significantly predicted ICT use and accounted for 8% of the variance of ICT adoption. The finding of adopter category as a significant predictor was consistent with many other studies as well (e.g., Almusalam, 2001; Isleem, 2003; Lee, 2002; Park, 2005; Sahin & Thompson, 2006).

For the second block predictor–perception of ICT attributes, the EFA demonstrated that 12 of the 50 items from Moore and Benbasat (1991) were meaningful in the Omani cultural context. Only three factors—compatibility, ease use or complexity, and relative advantage appeared to be culturally valid. This finding was consistent with Tornatzky and Klein (1982) and Surry and Gustafson (1994). They concluded that compatibility, relative advantage, and complexity were the most important in-

novation attributes related to innovation adoption. Agbonlahor (2006) also stated relative advantage and ease of use significantly influence the use of ICT by Nigerian universities lecturers.

The results of the regression analysis showed that perception of ICT attributes alone contributed additional 11% to the prediction. Furthermore, it was more important than adopter category in the two-predictor model. This finding of ICT attributes as a salient predictor of ICT adoption was also consistent with others (e.g., Almusalam, 2001; Isleem, 2003; Park, 2005).

When the seven personal-level variables were included in the prediction model as the third block, they collectively only explained another 5% of the variance of ICT use. Of the seven variables, only experience with computers and ownership of a mobile phone computer demonstrated a marginal significance. All of the other personal-level characteristics including gender, age, academic rank, teaching experience in higher education, and ownership of a notebook computer were relatively unimportant.

The insignificant impact of demographic variables on ICT adoption has been reported by many others (e.g., Cardwell-Hampton, 2009; Dusick & Yildirim, 2000; Isleem, 2003; Jegede, 2009; Meyer & Xu, 2007; Zare-ee & Shekarey, 2010). The marginal significance of experience of computers was also found in others (e.g., Sahin & Thompson, 2006; Ulmer, Watson, & Derby, 2007). So far, there has been little research evidence on the importance of the experience with a mobile phone computer on ICT adoption. However, Drent and Meelissen (2008) reported that the “personal entrepreneurs” type of teachers was strongly associated with integration of ICT in teacher education in Netherland. On the other hand, this study was different from those reported certain demographics as significant predictors (e.g., Alnujaidi, 2008; Pegler, Kollewyn, & Crichton, 2010; Yidana, 2008).

Finally, the numbers of traditional and blended classes currently teaching as the indices of workload were found to be significant. They together accounted for additional 11% of the variance of ICT adoption. The number of traditional classes teaching even surpassed adopter category to be the second important predictor after ICT attributes although on the negative direction. This finding suggested that teaching traditional classes has an adverse impact on ICT adoption. Conversely, teaching blended classes significantly related to ICT use. Although this variable was less important than adopter category, it was far greater than any personal-level variables.

## 6. LIMITATION OF THE STUDY

The findings of this study should be considered in light of the following study limitations. First, as this study used a convenience sample, the generalizability of this study was limited. Second, as there were no ethnographically valid surveys for the Omani or Arabic cultural context suitable for the purpose of the present study, the survey used in this study originated from the Western culture. Although the content validity of the survey has been confirmed by a panel of experts, and the CFA/EFA techniques were used to validate and extract the culturally responsive factors, its validity still needs to be further examined. Third, this study only focused on a few variables. Other personal, institutional, technological, socioeconomic, and cultural factors not explored by the current study may still significantly impact ICT adoption in Omani faculty members. Fourth, this study was a correlational investigation, rather than a well-controlled experimental study. Hence, any causal conclusions cannot be made from the results of this study. Last but not the least, this quantitative study suffers from all of the weaknesses of a quantitative inquiry. Qualitative or mixed method approaches may reveal a more holistic view of ICT adoption from multiple angles.

## 7. CONCLUSION AND SIGNIFICANCE

The present study reported that the current status of ICT use in the Omani faculty members at SQU was still unsatisfactory. It found that the distribution pattern of the five adopter categories on ICT adoption in SQU faculty was positively skewed, different from the normal distribution as in Rogers (2003). It identified the meaningful ICT attributes in the Omani cultural context were compatibility, ease of use or complexity, and relative advantage. Moreover, the results of the study supported Rogers' claims of adopter category and ICT attributes as important factors influencing adoption of an innovation in the Omani cultural context. Furthermore, this study demonstrated that teaching blended classes facilitated ICT adoption, whereas teaching traditional classes had a negative impact on ICT use. On the other hand, it found that many personal variables, both demographic and professional, including gender, age, academic rank, teaching experience, and experience with computers did not predict ICT use when they were concurrently considered with the adopter category, ICT attributes and the two job-related variables.

The present study can be seen to contribute to the existing body of knowledge in several ways. First of all, different from many existing studies focusing on some specific areas of ICT adoption in the Omani cultural context, this study took a board perspective with regard to ICT use. It considered a wide range of possible ICT ap-

plications in today's technological and educational environments in Oman. Such a scope was needed to provide an overall picture of ICT adoption in the Omani faculty members. Secondly, many studies on ICT adoption conducted in Oman were atheoretical. This study, instead, was driven by Rogers' theory of diffusion of innovation. It not only attempted to use Rogers' DoI theory to explain ICT adoption in the Omani faculty members, but also provided empirical evidences to verify Rogers' theory. Thirdly, this study concurrently explored several personal, psychological, and contextual factors which may affect ICT adoption.

The findings from the present study had several theoretical implications. First of all, the findings from the study generally supported Rogers' concept of adopter category. In other words, earlier adopters were more likely to use ICT in the instructional process than the later adopters. However, the results did not exactly buttress Rogers' classification of adopter categories at the micro level. The positive skewed distribution of the adopter categories in the current sample may suggest that Rogers' classification of the five types of adopters is too detailed. A category of two or three types may be more appropriate for the modern Omani higher education context.

Secondly, although the study found that ICT attributes significantly predicted Omani faculty' ICT adoption at the collective level, neither Moore and Benbasat's (1991) eight-factor structure nor Rogers' (2003) five-factor structure showed validity in the Omani culture. Instead, only relative advantage, compatibility, and complexity demonstrated culture relevance. These findings may indicate that the Western constructs do not necessarily have adequate cross-cultural validity in Oman. The Omani faculty members may not perceive ICT attributes as granularly as their Western counterparts do.

Thirdly, although Rogers did not explicitly discuss the importance of the job-related variables on adoption of an innovation, this study showed that the numbers of traditional and blended classes currently teaching considerably related to ICT use. These findings suggest that Rogers' DoI theory may need to be further refined or modified to include the job-related factors in today's technological and educational environment, at least in the Omani cultural context.

The practical implications of the findings from the present study were obvious. First of all, this finding found that the Omani faculty members at SQU have not utilized ICT at a regular basis in their instructional process. Thus, there is much room to promote ICT use at the university, especially in the unpopular functional areas of ICT functions related to teaching, learning, and research. Secondly, since perception of ICT attributes was the most influential factor, the university needs to help its

faculty members appreciate the advantages of ICT, make ICT easy to use, and improve the compatibility between ICT and the job duties or faculty's personal styles. Similarly, based on the findings, SQU needs to improve faculty member's self-image as an ICT adopter through training or other means. Lastly, to encourage ICT adoption in the instructional process, SQU should balance the numbers of traditional and blended classes, or increase the number of online classes for each instructor.

## **8. RECOMMENDATIONS AND FUTURE RESEARCH**

Recommendations for future research can be made in light of the previous discussion and limitations of the study. In the forefront, this study used the concept of ICT adoption or ICT use in a comprehensive and generalized way. It did not separate instructional ICT use from other types of computer use. It may be worthwhile to differentiate diverse types of ICT use as they may have different models as reported in some studies (e.g., Elster, 2010; Sahin, 2008). Additionally, the effects of the demographic predictors such as age may begin to appear due to the separation of ICT use (Pegler, Kollwyn, & Crichton, 2010).

Secondly, for the potential factors influencing ICT adoption, the present study only focused on 11 variables, other personal, institutional, technological, socioeconomic, and cultural factors may significantly influence faculty members' ICT adoption as well (Javeri & Persichitte, 2010). Future studies need to include additional important variables based on the literature in the investigation.

Thirdly, from the perspective of measurement instrument, as an ethnographically valid questionnaires for the Omani or Arabic cultural context was unavailable, the current study, like many other studies with an Omani or Arabic sample, employed a survey originated from the Western culture. Although its content validity had been confirmed by a panel of experts, and EFA was used to extract the culturally relevant constructs, it had not thoroughly been validated in the Omani culture. Future research needs to further improve the cultural validity and psychometric properties of the survey and develop other aboriginal measurement instruments.

Last but not the least, further investigation using a mixed method of qualitative and quantitative methods will be more useful and would clear some of the aspect that did not seem very specific. Quantitative researchers often cannot find in depth the specifics of the problem that they are investigating. When mixed methods research is used, it provides a better understanding of the problem for all parties involved, the researchers, their subjects, and the readers of the study (Fillion, Limayem, Laferriere, & Mantha, 2009; Kidd, 2010; Zare-ee, 2011).

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## MULTIPOLE MIXING RATIOS ( $\delta$ ) OF $\gamma$ - TRANSITIONS IN ( $^{95}\text{Sr}$ ) ISOTOPES

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### **ABSTRACT**

The  $\delta$ - value for gamma transition between the energy levels of  $^{95}\text{Sr}$  Isotope, has been calculated, by using the Constant Statistical Tensor (CST) method. The present results confirm the validity of this method in the calculation of multipole mixing ratio values for exiting levels. Our results show a good agreement with the results of previous work by Hwang, (2004) and give more prediction than Goodin, (2008) and Hwang, (2004) .

## 1. INTRODUCTION

The Physical Quantity ( $\delta$ )\_ can be considered from angular distribution measurements in phase convection of Steffen and Alder (1969) .

The values of multipole mixing ratio( $\delta$ )\_ can be used in the description of nuclear structure and transition properties [ Krane .K .S and Steffen R.M( 1970) ; Boher .A and Mottelson .B (1953)]. The constant statistical tensor method is one of important method which can be used in the calculation of ( $\delta$ ) values for gamma-transitions emitted from excited levels populated in radioactive isotope (Boher .A and Mottelson .B (1953)&Yamazaki .T (1967)] .

The statistical tensor coefficient is the same for all levels with the same spin value. It does not depends neither upon energy levels, nor upon its parity.

## 2. THE AIM OF THE WORK

The aim of the work is to calculate multipole mixing ratios  $\delta$  for  $^{95}\text{Sr}$  isotope and the validity of CST-method in the calculation of  $\delta$ - values.

## 3. DATA REDUCTION AND ANALYSIS

The multipole mixing ratios  $\delta$ - values can be calculated according to the following equation:

$$a_2(J_i - J_f) = \rho_2(J_i) \times \left[ \frac{(F_2(J_f L_1 L_1 J_i) + 2\delta F_2(J_f L_1 L_2 J_i) + \delta^2 F_2(J_f L_2 L_2 J_i))}{1 + \delta^2} \right] \quad (1)$$

Where;

$a_2(J_i - J_f)$  is the coefficient determined experimentally, Goodin . C (2008)

$J_i$  &  $J_f$  are the initial and final spin states.

$\rho_2(J_i)$  are the statistical tensor coefficients depending only on the value of  $J_i$ ;

$L_1$  &  $L_2$  are the angular momentum of the  $\gamma$ - transition,  $L_1 = 1$ ,  $L_2 = L_1 + 1$  and  $L \neq 0$

In the case of  $\delta = 0$  the  $\gamma$ - transition is pure i.e. the transition must be either pure electric transition or pure magnetic transition; therefore the equation (1) can be re-

duced to the following form

$$a_2(J_i - J_f) = \rho_2(J_i) \times F_2(J_f L_1 L_1 J_i) \dots \dots \dots (2)$$

Then the statistical tensor  $\rho_2(J_i)$  is;

$$\rho_2(J_i) = \frac{a_2(J_i - J_f)}{F_2(J_f L_1 L_1 J_i)} \dots \dots \dots (3)$$

The values of  $\rho_2$ , which have been calculated according to the equation (3), are listed in Table I, with the values of  $F_2(J_f L_1 L_1 J_i)$ .

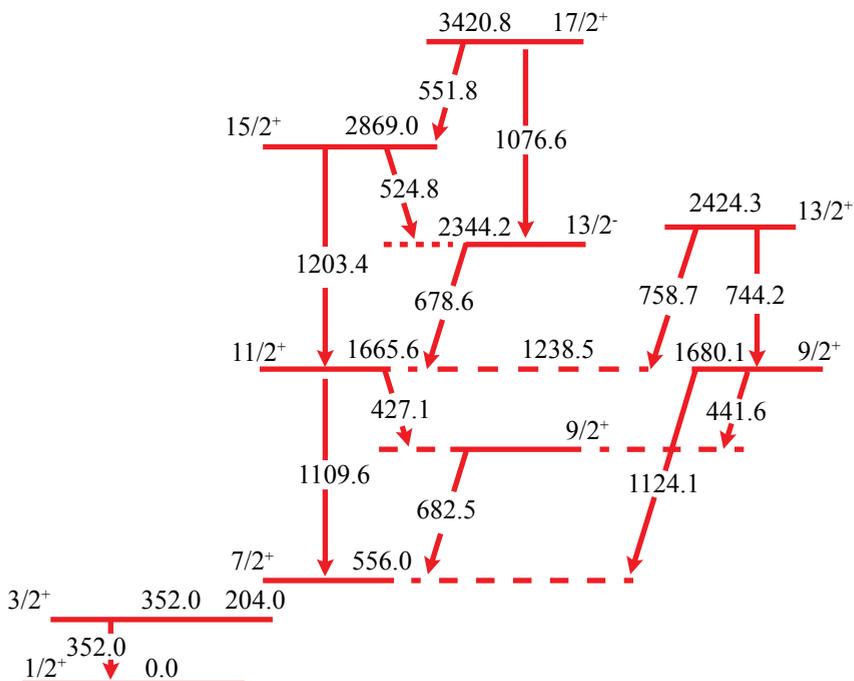
TABLE I The values of $\rho_2(J_i)$ and the values of $F_2(J_f L_1 L_1 J_i)$		
	$\rho_2(J_i) = \frac{a_2(J_i - J_f)}{F_2(J_f L_1 L_1 J_i)}$	$F_2(J_f L_1 L_1 J_i)$
1	$\rho_2(\frac{3}{2}) = 0.0540$	$F_{211} = 0.5000$
2	$\rho_2(\frac{7}{2}) = -0.2032$	$F_{211} = -0.4675$
3	$\rho_2(\frac{9}{2}) = 0.3929$	$F_{211} = 0.3028$
4	$\rho_2(\frac{11}{2}) = -0.4589$	$F_{211} = 0.2876$
5	$\rho_2(\frac{13}{2}) = 0.6669$	$F_{211} = 0.2774$
6	$\rho_2(\frac{13}{2}) = 0.2956$	$F_{211} = 0.2774$
7	$\rho_2(\frac{13}{2}) = 0.1463$	$F_{211} = -0.3962$
8	$\rho_2(\frac{15}{2}) = 0.5335$	$F_{211} = 0.2699$
9	$\rho_2(\frac{17}{2}) = 0.1470$	$F_{211} = 1.0$
10	$\rho_2(\frac{17}{2}) = 0.1470$	$F_{211} = 1.0$

The present values of  $\delta$ - mixing ratios are predicted in Table II according to equation (1)

TABLE (II) Prediction of $\delta$ -mixing ratios values		
	$a_2(J_i - J_f) = \rho_2(J_i) \times \left[ \frac{(F_2(J_f L_1 L_1 J_i) + 2\delta F_2(J_f L_1 L_2 J_i) + \delta^2 F_2(J_f L_2 L_2 J_i))}{1 + \delta^2} \right]$	$\delta$
1	$a_2\left(\frac{3}{2} - \frac{1}{2}\right) = 0.0540 \times \frac{(0.5000 + 2 \times 0.8660\delta - 0.5000\delta^2)}{1 + \delta^2}$	- 0.5773
2	$a_2\left(\frac{7}{2} - \frac{3}{2}\right) = -0.2032 \times \left[ \frac{(-0.4675 - 2 \times 0.5051\delta - 0.5455\delta^2)}{1 + \delta^2} \right]$	- 12.9538
3	$a_2\left(\frac{9}{2} - \frac{7}{2}\right) = 0.3929 \times \left[ \frac{(0.3028 - 2 \times 0.9354\delta - 0.0197\delta^2)}{1 + \delta^2} \right]$	- 5.7998
4	$a_2\left(\frac{9}{2} - \frac{7}{2}\right) = 0.3929 \times \left[ \frac{(0.3028 - 2 \times 0.5593\delta - 0.0275\delta^2)}{1 + \delta^2} \right]$	- 5.7998 or $3.5 \times 10^{-5}$ .
5	$a_2\left(\frac{11}{2} - \frac{9}{2}\right) = -0.4589 \times \frac{(0.2876 - 2 \times 0.9299\delta + 0.0188\delta^2)}{1 + \delta^2}$	- 6.917
6	$a_2\left(\frac{13}{2} - \frac{9}{2}\right) = 0.6669 \times \frac{(0.2774 - 2 \times 0.9119\delta - 0.0396\delta^2)}{1 + \delta^2}$	0.2709 or - 9.824 7.6668 or - 0.267
7	$a_2\left(\frac{13}{2} - \frac{11}{2}\right) = -0.2956 \times \frac{(0.2774 - 2 \times 0.9119\delta - 0.0396\delta^2)}{1 + \delta^2}$	- 5.7533
8	$a_2\left(\frac{13}{2} - \frac{11}{2}\right) = 0.1463 \times \frac{(-0.3962 - 2 \times 0.5742\delta + 0.1403\delta^2)}{1 + \delta^2}$	4.3084 or - 0.0568
9	$a_2\left(\frac{15}{2} - \frac{13}{2}\right) = 0.5335 \times \frac{(0.2699 - 2 \times 0.5040\delta + 0.1403\delta^2)}{1 + \delta^2}$	0
10	$a_2\left(\frac{17}{2} - \frac{13}{2}\right) = 0.1470 \times \frac{(-0.2699 - 2 \times 0.9142\delta + 0.0567\delta^2)}{1 + \delta^2}$	1
11	$a_2\left(\frac{17}{2} - \frac{15}{2}\right) = 0.1470 \times \frac{(1)}{1 + \delta^2}$	1

### 4. DISCUSSION

The levels scheme “Fig.(1)” of  $^{95}\text{Sr}$  with spine and parities assigned in work of C. Godin (2008) has been used in present calculation of  $\delta$ - mixing ratios.



FIG(1) Gamma transition between energy levels populated in the decay scheme of ( $^{95}\text{Sr}$ ) isotope.

For any transition of a  $\frac{3}{2} \Rightarrow \frac{1}{2}$ ,  $a_2$  and  $a_4$  are identical zero. The multipolarity of the 204.0 **1076.6 KeV** transition to  $\frac{3}{2}$  has been confirmed by Kratz (1983) to be  $E_2$  and **1076.6 KeV** cross over transition is  $E_2$ .

It is obvious that most of our results for delta in this Paper, gives + or - value for delta according CST rather than zero as in others. This a very good indication for the validity of CST.

The energy levels, the  $\gamma$  transition, the initial and final spins for each transition beside  $a_2$  are listed in table III and the  $\delta$ - mixing ratios of the present work (CST) compared with  $\delta$  with Goodin(2008) and Hung(2004) results are shown in the table(III).

Table III Comparisons of  $\delta$ -mixing ratios of our work with *Goodin(2008) and Hung(2004)*

	Energy level (KeV)	$\gamma$ -transition KeV	$J_i^\pi$	$J_f^\pi$	$a_2$	$\delta$ Values		
						$\delta(CST)$	Goodin (2008)	Hung (2004)
1	352.0	352.0	$\frac{3}{2}^+$	$\frac{1}{2}^+$	-0.021	-0.5723	0	—
2	556.0	204.0	$\frac{7}{2}^+$	$\frac{3}{2}^+$	-0.027	-12.9538	1.0	0.0
3	1238.5	682.5	$\frac{9}{2}^+$	$\frac{7}{2}^+$	0.095	-5.7998	—	—
4	1680.1	1124.0	$\frac{9}{2}^+$	$\frac{7}{2}^+$	0.119	-5.7998 or $3.5 \times 10^{-5}$	0.87	—
5	1665.6	427.1	$\frac{11}{2}^+$	$\frac{9}{2}^+$	-0.132	-6.9717	0.0	1
6	2344.2	659.1	$\frac{13}{2}^+$	$\frac{11}{2}^+$	0.185	0.2709 or -9.8246	-0.32	0
7	2424.3	744.2	$\frac{13}{2}^+$	$\frac{9}{2}^+$		7.6668 or -0.2072	-0.32	0.0
8	2424.3	759.2	$\frac{13}{2}^+$	$\frac{11}{2}^+$	0.082	-5.7533	2.6	0.0
9	2869.0	524.8	$\frac{15}{2}^+$	$\frac{13}{2}^+$	-0.058	4.3084 or -0.0568	0.0	0.0
10	3420.8	551.8	$\frac{17}{2}^+$	$\frac{15}{2}^+$	0.147	1	0.0	2.6
11	3420.8	1076.6	$\frac{17}{2}^+$	$\frac{13}{2}^+$	0.147	1	0.0	0.0

Table (III) lists the compression of  $\delta$ - mixing ratios between the values of this work [constant statistical tensor (CST )] with results of Yamazaki .T, (1967) & . Hwang, (2004), the present values are more accurate than their results.  $\delta$ - mixing ratios of transition are given zero value by Goodin (2008) and Hung (2004) while our calculations show minus value of (  $\delta$  ) . The ratios of

transition  $J_i^\pi = \frac{9}{2}^+$  and  $\frac{13}{2}^+$  of  $E_\gamma = 1124.1$  , 678.6 and 744.2KeV respectively show two values of  $\delta$ - mixing ratios, one of them agrees with our results.

## 5. CONCLUSION

We conclude that it is possible to calculate delta mixing ratio using Interacting Boson Approximation (IBA) as an equivalent to the present calculation.

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**E-GOVERNMENT ADOPTION AND IMPLEMENTATION IN  
OMAN: A GOVERNMENT PERSPECTIVE**

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**Dr. Qasim Al-Mamari**

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**ABSTRACT**

This thesis reports a description and analysis of the factors that influenced the process of adoption and implementation of the e-Government initiative in Oman over the period 2000 - 2013. The research provides an explanation of why government organisations in Oman developed and then adopted e-Government projects, and how that affected their success as an example of what might also be the case in many developing countries.

Data was collected using a theoretical framework developed from the extant literature, and analysed using Institutional Theory. The findings suggest that the Omani Government was motivated to adopt e-Government as a service to the people of Oman because of a perceived need to conform to world standards and improving the performance of the public sector. The intention in Oman was also to adopt e-Government services to improve efficiency in relations with various government departments as a means to attract foreign direct investment and to create a knowledge-based industry.

The study shows that while it was considered important for Oman to adopt e-Government, the progress of implementation was slow with an observable mismatch between the rhetoric of the implementation strategy and the actual outcomes. This mismatch, the study argues, is associated with interrelated challenges within the institutional infrastructure which lacked integration and the requisite IS/IT knowledge, and with the technology infrastructure which lacked reliable high-speed network coverage.

The study concludes that although a strong will for the adoption and implementation of e-Government existed, coupled with sufficient financial resources, the necessary human and technological resources to overcome implementation obstacles did not exist. The study shows that the implementation was episodic: the implementation

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of e-Government in Oman was launched in 2003, discovered to be stalled in 2011, and was restarted in 2012.

As the focus of the study was on the supply-side of e-Government, an important theoretical contribution of this study is the development of a framework of e-Government adoption motivators. Using the concept of institutional decoupling, this framework offers a new understanding of the observed high failure rate of e-Government implementation in many developing countries.

In terms of practical contributions, important lessons can be learnt particularly with regard to synchronising motivating factors with institutional, technological and organisational prerequisites, and expected outcomes. In other words, governments should establish a clear and close link between means and ends prior to implementing e-Government initiatives by engaging relevant stakeholders in the design process to avoid mismatch between project design and reality.

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# ON THE COMPETITION BETWEEN MULTINATIONAL ENTERPRISES WITHIN DEVELOPING COUNTRIES: DEVELOPING COUNTRY MNEs VERSUS DEVELOPED COUNTRY MNEs

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**Dr. Awadh Ali Almamari**

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## **ABSTRACT**

Over the last two decades, developing countries have experienced a high volume of foreign direct investment (FDI). It is commonly accepted that many multinational enterprises (MNEs) are entering into multiple markets, in order to increase their profitability and to reduce the risk of relying upon one market.

This study aims to provide insight into the internationalisation of MNEs from both developed and developing countries into developing markets. It seeks to test what, if anything, MNEs from developing countries do more effectively than MNEs from developed countries within these emerging markets.

The central thesis of the study is that MNEs from developing countries will have certain advantages over MNEs from developed countries, and will therefore be more prevalent amongst the largest foreign firms within emerging markets. This thesis is based on the assumption that MNEs from developing countries have prior experience of operating within similar emerging markets, and so are better qualified to compete within these types of markets. MNEs from developing countries obtain certain capabilities from operations within their home countries, such as the ability to function in the context of authoritarian regimes, ineffective governments, poorly developed infrastructures, and poorly protected property rights, as well as the ability to provide services within markets which include consumers living in poverty. All of these may allow them more easily to overcome difficulties and setbacks within developing country markets.

The theoretical foundation for this study has been constructed by reviewing the existing business literature. A particular aim of the literature review was to understand and explore the development of knowledge about the investment habits of multinational enterprises. In particular, their behaviour when operating within developing country markets was explored, along with the question of how they may be able to use their resources or capabilities to gain competitive advantage. This

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produced a set of hypotheses, which were then investigated using two types of data (both quantitative and qualitative).

The results of the analysis show that developing-country MNEs outperform developed-country MNEs when investing in developing countries with poorly protected property rights and pervasive corruption. This is also the case when investing in countries with poorly developed infrastructure. In addition, partial support was found for the hypothesis that developing-country MNEs are likely to have an advantage over developed-country MNEs when investing in developing countries with authoritarian regimes.

The study hopes to assist policy makers in recognising that an MNE's previous experience impacts on its ability to succeed in developing countries. It also hopes to provide useful guidance for those MNE managers who are seeking to improve their effectiveness when investing in developing countries.

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## CONFERENCES & SYMPOSIUMS

### 1<sup>ST</sup> OMAN TOURISM INVESTMENT CONFERENCE

22 - 23 DECEMBER 2013

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Oman's 1<sup>st</sup> Conference on Tourism Investment was held at Al Bustan Palace Hotel under the patronage of HH Sayyid Taimour bin Asa'ad bin Tariq Al-Said, Assistant Secretary-General for International Cooperation at The Research Council (TRC).

The Conference was organized by Oman Chamber of Commerce and Industry (OCCI) in collaboration with the Federation of the GCC Chambers and lasted for two days.

The conference highlighted the tourism potentials in the Sultanate and the investment climate in the tourism sector as it is an industry that can be relied on in increasing the GDP of any country. This is especially important in the attempt of the GCC states to diversify sources of income and the shift to the service sector in achieving reliable revenue and providing jobs as well.

Mr. Khalil bin Abdullah al-Khunji, Chairman of OCCI and Chairman of the Federation of GCC Chambers gave a speech in which he stated that the OCCI seeks in cooperation with the Federation of the GCC Chambers, to shed more light on the importance of this sector in general and to highlight areas of investment. This cooperation aims to exchange local and international experiences in the development of tourism investment and to learn about the developments in this sector and the future vision for its development from training, funding and legislative aspects. In addition, it hopes to open discussion between the employers and investors in this sector to reach a common vision to promote joint GCC investment.

The first day of the Conference had two sessions: the first session was entitled "Integration of Promotion, Training and Tourism". Four papers were presented during the 1<sup>st</sup> session. They were entitled "Potential of Tourism Investment in the Sultanate of Oman: Private Sector Perspective", "Strategic Vision for Sustainable Tourism in the Sultanate of Oman", "How to Create an Assertive Tourism and Investment Generation and the Factors Affecting Students' Initiatives in Tourism", and "The Role of Training Programmes in the Rehabilitation of the Outputs for the Needs of the Tourism labour market".

The second session was entitled "Tourism Climate in the Sultanate : Regional Perspectives. Three working papers were presented. They were; "Guarantees of

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Tourism Investment, The Latest Methods of Electronic Marketing for Tourism and the results of a project to develop tourism in the Member States of the Association of Indian Ocean Rim States which was presented by the Tourism Organization for the countries of the Indian Ocean Rim Association for Regional Cooperation.

Representatives from the governmental institutions, the private sector establishments, businessmen from the Sultanate, GCC Countries, Arab and foreign countries participated in the conference.

The Conference came up with more than 16 recommendations. Among the most important of which are:

- The drawing of tourist map of tourism and archaeological landmarks in the Sultanate .
- The rehabilitation of tourist places in terms of the availability of basic services.
- Adopting strategies for tourism promotion and marketing of tourism projects in Oman with the importance of having an efficient tourist media that has professional capabilities needed for the revitalization of national tourism.
- Amending tourism legislations periodically to keep pace with new developments.
- Regulating the specifications and standards that take into account the quality of services provided and a sustainable environment-friendly tourism.
- Highlighting some archaeological sites and showing their association with holidays and occasions.
- making use of some archaeological buildings (like some ancient castles and forts) in economic activities.
- The creation of an effective partnership between the Government and the private sector to update promotions and encourage tourism.
- Highlighting investment incentives in the Sultanate to attract GCC and foreign investors in the tourism sector.
- Community involvement in the development of domestic tourism by adopting ideas and initiatives that can serve the sector.
- spreading a culture of entrepreneurship in tourism that includes all components of the sector, such as tourism offices, rest areas, parks and other projects.

The Conference called to promote Arab-Gulf alliances in the tourism sector by establishing Gulf-Arab hotels to benefit from the experiences of all the Gulf coun-

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tries in this area. It also emphasizes the contribution of the stakeholders in the Sultanate to the support of hotel marketing, in the light of joint refresher programmes and paying attention to close collaboration between the institutes and colleges of tourism and the exchange of experience among them, both domestically and internationally.

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## **Guidelines to Authors and Submission of Manuscripts**

1. All contributions will be evaluated by at least two independent referees. Papers should be original and should not have been published or under consideration for publication elsewhere in any form.
2. Contributions submitted for publication should be in English.
3. Papers should be sent on a disk together with three hard copies.
4. Author(s) should provide abstracts in English of up to 150 words.
5. Contributions should be no longer than 30 pages, not exceeding 300 words per page.
6. Author(s) should submit a request for publishing his/ her contribution stating that it has not been published before.
7. The author(s) should type the following on a separate page: title of the paper, the name(s), postal and E-Mail address(es) of the author(s), and the telephone number(s). Title of the paper should appear on the first page.
8. Applied and academic papers in the fields of Science in Communication, Design, Information Technology, International Business, Engineering & English language will be published in the periodical.
9. Notes, footnotes and endnotes are listed at the end of the paper in numerical order as they appear in the text.
10. Full bibliographical details of references should be given and listed in alphabetical order as follows:
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