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BIOMETRIC IDENTITY CARDS AS A TOOL FOR E-GOVERNANCE IN SULTANATE OF OMAN

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ABSTRACT

The study makes an attempt to analyze the efficient role of biometric identity cards as a tool for E-Governance as perceived by the citizens of Sultanate of Oman. The study uses a structured questionnaire to collect data from a sample of 339 respondents. Structural Equation Modelling (SEM) was used through AMOS to test the hypotheses and build a model using four indicators and 18 items. The results reveal that Timeliness and Accuracy have a significant impact on Efficiency of Biometric card as an E-Governance tool. The study has found that citizens of the Sultanate are overall satisfied with the role played by biometric identity cards in ensuring good governance. Limitation of study is that it was undertaken in Oman only and thus poses problems when extrapolating the findings to other countries. Biometric identity cards are used to facilitate and monitor efficient delivery of services such as education, healthcare, immigration and employment by the government and so have been adopted with varying degrees of success by countries across the world. Research in the Middle East especially Sultanate of Oman is scarce and the study develops a model based on the perception of residents and identifies some grey areas in the implementation and integration of the services where improvements are needed.

JEL Classification: O38, M21, G18, D04, G38

Key words: E-Governance, Biometric, Efficiency, Timeliness, Sultanate of Oman

1. INTRODUCTION

Since the turn of the century, E-Governance has become a dominant means of service delivery by government all over the world. It is atool for good governance as it helps the government to be responsive, deliver quality service, interact with citizens, cut costs and promote transparency and accountability. The success of E-Governance as a tool for public service delivery is possible through a robust biometric technology.

Biometrics refers to authentication and identification of an individual based on personal and behavioral characteristics. Biometrics uses distinctive physical characteristics or personal traits to identify an individual or verify the claimed identity of an individual (Woodward, Orlans, and Higgins, 2003). It uses personal identification such as fingerprints, iris scans and DNA identification to identify the user and stores the information in an integrated database. Kazimov and Mahmudova (2018) have highlighted the usefulness of biometrics in the fight against terrorism and criminals and in implementing security measures in sensitive sites and workplaces. According to Smyth (2019), formal identification and authentication systems are becoming crucial for peoples' dealings with both public and private institutions. The process of collecting and organizing information is now a tremendous source of economic, political and cultural power. More governments across the world are building citizen identification registers using biometric technology. Failure to register citizens and provide them identity documents will have detrimental effects. Digital technologies can mitigate some of the problems of paper based registers such as duplication, forgery, false rejections and acceptances. Modern biometrics offer the promise of improved authentication. Biometrics is a global growth industry and the global market for these services is estimated to have crossed USD$17 billion in 2018 (Smyth, 2019). Biometric technology provides reliable identification of individuals and protects the integrity of sensitive data stored in information systems. As a result, several governments have implemented biometric authentication systems to efficiently and securely provide services to citizens.

Sultanate of Oman is the first country among the Middle East countries to introduce the smart card based identity. The Biometric National Identity Card was introduced in the Sultanate in 2002 by issuance of Royal Decree 66/99 and it constitute a new Civil Status Registry. The Biometric National Identity Card came into reality in

2004. Royal Oman Police (ROP) is the local authority given responsibility for managing this project. The Sultanate introduced the biometric identity card to simplify and accelerate administrative processes, provide quality public services to citizens, strengthen citizen identity and e-government services. The biometric identity card popularly known as the resident card has the citizen's fingerprint, photograph for identity, and demographics such as date of birth, occupation and so forth. Every card has an embedded microchip containing the citizen's biometric data such as marital status, passport number, driving licence data and level of education. Every citizen has a unique civil number by which they are identified. The biometric identity card supports driving licence, passport, health care card, electronic voting and digital signature. Sultanate of Oman has used digital infrastructure and technology to reach citizens and deliver services. Hence Electronic Governance or E-Governance is use of technology adopted by governments to link different services to deliver accurate and fast service transactions to bring change in the life of citizens by better governance.

The purpose of this research is to identify the efficient role of biometric identity cards as a tool of E-Governance as perceived by the Sultanate of Oman citizens. The research paper uses questionnaire and interview method to get responses from citizens regarding their perception. The questionnaire was administered by random sampling to 339 respondents in the Sultanate of Oman. Factor Analysis was done to evaluate the responses. The research focuses on the views of the citizens and their own experience regarding the biometric identity cards.

2. REVIEW OF LITERATURE

Abundant studies have been done on biometric cards and E-Governance in several countries. But very few studies have focussed on Biometric cards and E-Governance in the Sultanate of Oman.

The effectiveness and efficiency of using biometric technology by any country is based on its robust national database. Some indicators of biometric system efficiency are relevance, capacity, efficiency, timeliness, accessibility, flexibility, accuracy, reliability and security (Wilkinson, 1992). The essential requirement of biometrics in E-Governance is to provide measures to reduce vulnerabilities. Biometric systems increase data productivity, reliability and accuracy (Indrayani, 2014). Today such systems are

used in various E-Governance applications such as banking security, electronic fund transfers, ATM security, credit card transactions, physical access control such as airport access control and government welfare disbursement programs. Biometric system in the form of national ID provides a unique identity to citizens which can integrate different government services such as providing voter registration facilities, health facilities, customs and immigration services (Piyush, 2012). The biometric systems have been attracting interest due to their functionality, speed, accuracy, reliability and ease of use (Oh, Lee and Lee, 2018). The Department of Homeland Security in the USA, one of the biggest users of biometric technology, uses the technology to detect and prevent illegal entry, to verify information on visa applications and to facilitate legal travel and trade. The Automated Biometric Identification System, a repository processes more than 300,000 biometric transactions per day and holds biometric data on more than 250 million people. It has helped the federal government to apprehend criminals and solve several previously unsolved crimes (www.fedtechmagazine.com, 2019). The idea of 'biometric vision' which states that biometric information can serve to increase control of mobility by enhancing government agency capacity for monitoring and exchanging information about individuals was propagated by Delgado (2017), the study explicated how existing biometric practices, such as fingerprinting and access control, are now being transformed and expanded to improve security and efficiency in governing global mobility. Adams and Asante (2019) in their study on voter experience in Ghana in using the biometric system for voter registration and verification found that introducing the biometric system in election management influenced the turnout for both the educated and the uneducated. However, there were implementation drawbacks as all citizens were anticipated to have the same level of technological knowledge and capability, leading to marginalization and neglect of a large section of the population. Understanding users' or citizen's perception is a key factor for Biometric Identity cards and E-Governance.

Research was done on comparing the biometric system in Middle East countries with systems followed in other countries such as the United Kingdom (UK), Japan, Singapore and Korea. The driving force for biometric systems in any country are factors such as security, E-Governance, mobile society, cost, privacy and convenience (Khan, Khan and Alghathbar, 2010). The factors to evaluate any biometric technology are universality, permanence,

measurability, uniqueness, accuracy and reliability. (Hong, Jain, and Panakanti, 1999). Restructuring of operations, activities and processes needs to be done for the successful E-Governance implementation. To get full benefits, the focus should be on coordination and cooperation between different government organizations (Irani, Love, and Jones, 2008). Using biometric technology in E-Governance has its challenges. The major challenges are citizen's acceptance and usage (Sarrayiah and Sriram, 2015). This can be achieved by training and educating and creating awareness among citizens, updating technology regularly and getting guidance from knowledge based companies which helps in successful E-Governance implementation Critics complain that creating an extensive central register of personal information controlled by government will increase opportunities for the state to abuse citizens, for example searching records to target immigrants and other minorities (Smyth, 2019). Another challenge is lack of adequate legal framework, lack of integration of various government agencies and information quality (Al Busaidy and Weerakkodi, 2011). Lack of social and cultural awareness and computer literacy are also the biggest hindering factors for implementing biometric technology for E-Governance. The digital and cultural gaps which exists in a country blocks successful biometric technology implementation. To bridge these gaps will require a needs based program developed to apply E-Governance (Thamer and Steve, 2009). According to Dharavath, Talukdar and Laskar (2013) biometric technology is not fool proof. The challenge in biometric technology is low recognition rate of finger print (Layne and Lee,2001). E-Governance implementation faces challenges such as information security, user authentication and privacy for which biometric authentication is a potential solution in dealing with such concerns (Dearstyne, 2001). The two critical challenges facing biometric implementation are attacks on the user interface and template databases of biometric systems (Yang, et al., 2019). Designing measures to prevent the attacks and provide strong security while maintaining recognition accuracy is critical. The authors also emphasised the unsatisfactory results of recognition accuracy such as fingerprint, iris and face scanning in unfavorable conditions. The key to successful E-Government implementation is to provide access to citizens and users from one single integrated gateway and provide timely and reliable access to information (Adnan, 2015).

The uniqueness of biometric technology is to curtail and reduce crime, theft and terrorism in a country. The modern technological advances in biometrics and cryptography can be used

without compromising on system privacy (Paul, 2009). A biometric can identify an individual from the measurement of physiological properties which provide the ability to control and protect the integrity of sensitive data stored in information systems (Oppliger, 1997).

3. METHODOLOGY

A survey was administered in the Sultanate of Oman with the help of a structured and self-administered questionnaire to 339 respondentsselected at random. The objective of the study is to understand the perception of citizens regarding the efficiency of biometric cards as a tool of E-Governance in the Sultanate of Oman. A total of 18 items measured the four indicators which are Efficiency, Timeliness, Accuracy and Reliability. The indicators were selected based on past research. The respondent's opinion is taken on a five point Likert scale. The responses are ranked from 1 (strongly disagree) to 5 (strongly agree).

Efficiency of E-Governance system means minimising the time required to record, maintain and produce the data or information. Timeliness is the ability of the system to speed up the process and generate the required information on time. Reliability is the high standard of accuracy and reliability of the system such as resistance to breach and damage. Accuracy is the aspect of value of information generated by the biometric system. These indicators are measured with the help of 18 items. To investigate the impact of these indicators and to construct the model a questionnaire was administered. Exploratory Factor Analysis (EFA) and Structural Equation Modelling (SEM) are used through AMOS program to test the hypotheses.

The following hypotheses have been formulated for the present study:

H1: Timeliness has a significant impact on the perception of the respondents toward efficiency of biometric cards as a tool of E-Governance in the Sultanate of Oman.

H2: Accuracy has a significant impact on the perception of the respondents toward efficiency of biometric cards as a tool ofE-Governance in the Sultanate of Oman.

H3: Reliability has a significant impact on the perception of the respondents toward efficiency of biometric cards as a tool of E-Governance in the Sultanate of Oman.

Table 1 gives the four indicators and 18 items used to collect data from citizens about biometric card using a questionnaire.

TABLE 1
Survey Instrument

Indicator	Items	Coding
Efficiency	Resident card protects citizens' rights	E1
	Resident card secures citizens identity	E2
	Resident card has made life easier and better for citizens	E3
	Resident card is required for any transaction with the Government	E4
	Resident card helps the government to efficiently plan and distribute services	E5
	Resident card is efficient in helping job seekers find suitable jobs	E6
Timeliness	Resident card has made delivery of health services better, faster and more effective than before	T1
	Resident card is useful while filing and pursuing civil and criminal cases	T2
	Resident card makes it easy to check the criminal records of a person	T3
Accuracy	Resident card helps to identify and validate banking transactions	A1
	Resident card helps to track the credit history of a person	A2
	Resident card helps in keeping track of students' progress	A3
	Resident card is useful in getting treatment and admission in hospitals and clinics	A4
	Resident card ensures fairness and transparency in providing jobs for eligible citizens	A5
Reliability	Resident card helps in maintaining the database of students in colleges and universities	R1
	Resident card can identify eligible citizens and grant them scholarship benefits	R2
	Resident card helps in providing equitable access to enhanced health services to citizens	R3
	Resident card helps only eligible citizens to enroll for jobs in employment exchanges	R4

4. ANALYSIS AND FINDINGS

To analyze the data, Exploratory Factor Analysis (EFA) is used to determine the dimensions of the study variables. AMOS was used to confirm the exploratory factor model by determining the goodness of fit between hypothesized model and sample data. Structural Equation

Modelling (SEM) was applied on the data to test hypotheses; it is a methodology for representing, estimating and testing a number of relationships between variables (Byrne, 2001). The dependent variable is taken as efficiency and independent variables are accuracy, reliability and timeliness.

TABLE 2
Exploratory Factor Analysis

Factor	Symbol	Loadings	Variance Explained	Eigen values	Other Scales
Efficiency	E1	0.732	29.072	36.680	KMO =0.855 Bartlett's Test =210 Sig =0.000 Cumulative variance=62.01
	E2	0.666			
	E3	0.571			
	E4	0.950			
	E5	0.730			
	E6	0.519			
Timeliness	T1	0.527	14.527	12.744	
	T2	0.547			
	T3	0.599			
Accuracy	A1	0.657	6.506	7.376	
	A2	0.564			
	A3	0.577			
	A4	0.614			
	A5	0.508			
Reliability	R1	0.621	4.993	5.589	
	R2	0.635			
	R3	0.575			
	R4	0.766			
	R5	0.633			

Source: Calculated SPSS AMOS

In Table 2, it is noted that all conditions of Exploratory Factor Analysis (EFA) have been achieved (KMO =0.855 > 0.60, Sig=0.000 < 0.05, Cumulative Variance =62.01 > 60). Eigen values for every factor is greater than one. Exploratory Factor Analysis (EFA) revealed four constructs. To conduct the analysis AMOS program was used to determine the goodness of fit between the hypothesized model and sample data collected using questionnaire. Structural Equation Model (SEM) through

AMOS was conducted to show the effect of dimensions such as Timeliness, Reliability, and Accuracy (Independent variables) on the Efficiency (Dependent variable) of Biometric card as an E-Governance tool. Table 3 shows the fit indices of the model in the current study. The results mentioned indicate a good fit and the results are within the acceptable limits.

FIGURE 1
Exploratory Factor Analysis of Measurement Model

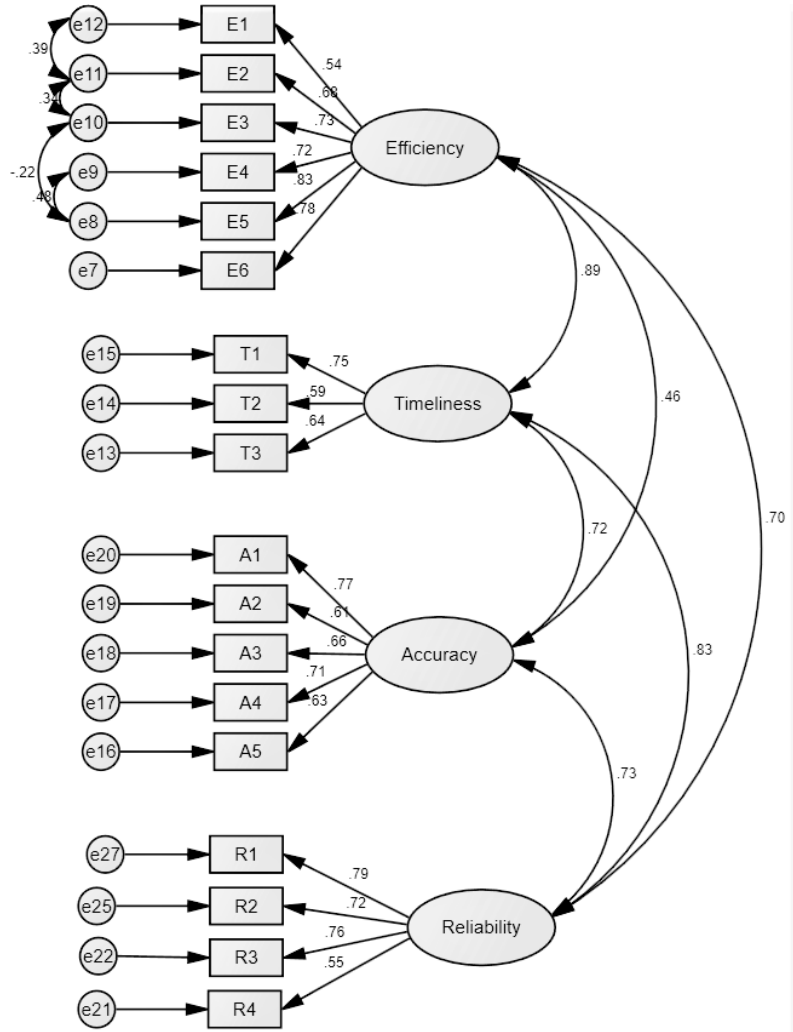

TABLE 3
Model Fit Indices

Indices	Symbol	Indices value	Criteria
Chi-Square(p=0.000)	X^2	468.22	< 0.05
Chi-Square/Degrees of freedom	CMIN/DF	4.893	< 5.00
Root Mean Square of Approximation	RMSEA	0.075	< 0.08
Root Mean Square Residual	RMR	0.060	< 0.10
Comparative Fit Index	CFI	0.853	> 0.90
Tucker Lewis Index	TLI	0.817	> 0.90
Incremental Fit Index	IFI	0.855	> 0.90
Normed Fit Index	NFI	0.824	> 0.90
Parsimony Normed Fit Index	PNFI	0.462	> 0.50
Goodness of fit Index	GFI	0.842	> 0.90
Parsimony Goodness of fit Index	PGFI	0.406	> 0.50

FIGURE 2
Structural Equation Model

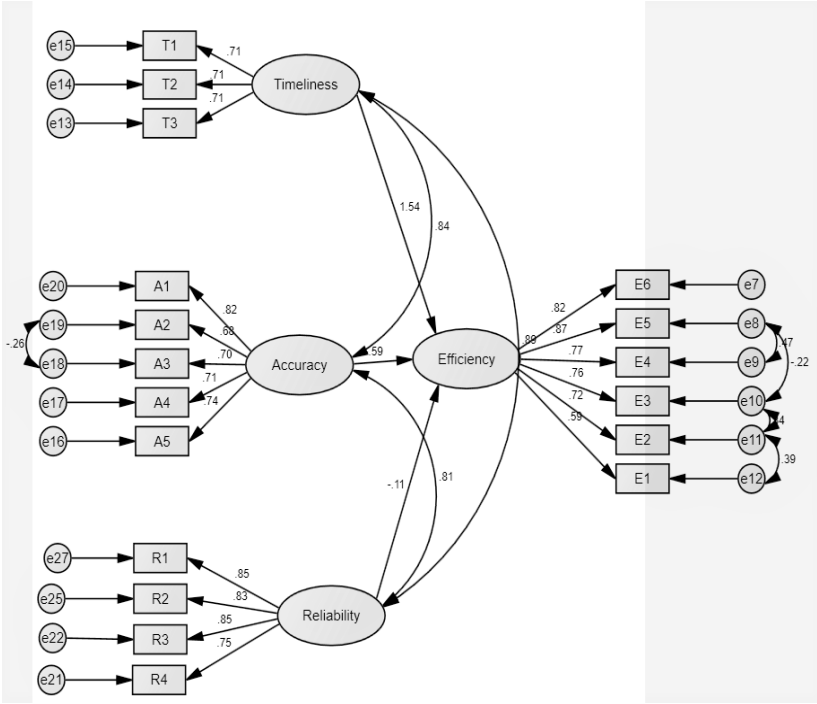

TABLE 4
Hypotheses Testing

H	Structural Path	Estimate	S.E	C.R	p value	Outcome
H_1	Efficiency ← Reliability	-0.108	0.159	-0.677	0.599	Not Supported
H_2	Efficiency ← Timeliness	2.220	0.248	8.971	* * *	Supported
H_3	Efficiency ← Accuracy	-0.771	0.161	-4.789	* * *	Supported

Notes: * * * indicate level of significance >0.001

From Table 4, it can be seen that two hypotheses are supported namely Accuracy has a significant impact on respondent perception toward efficiency of biometric cards as a tool of E-Governance in theSultanate of Oman (*p* value = 0.00). Timeliness has a significant impact on respondent perception toward efficiency of biometric cards as a tool of E-Governance in the Sultanate of Oman (β= 0.248, *p* value = 0.00). However, Reliability does not have a significant impact on respondent perception toward efficiency of biometric cards as a tool of E-Governance in the Sultanate of Oman (*p* value = 0.599) and is not supported. The results are in line with the findings of Scott and Hughes (2005) who found that accuracy and trust play a significant role in the feasibility and acceptance of biometrics as a component in delivering E-Government services.

5. DISCUSSION

As stated before, the objective of the study is to understand the perception of citizens regarding the biometric card as a tool of E-Governance in the Sultanate of Oman. The past research reflects multiple aspects, but the researcherdid not find any study on the perception of citizens toward biometric resident card as an E-Governance tool. Thus there is a gap in the existing literature in this area. This study aims at filling this gap by conducting a study in the Sultanate of Oman, which is the first country in the GCC region to implement biometric ID cards as an E-Governance tool. A model was developed using Exploratory Factor Analysis based on citizen perception. Three independent variables namely Timeliness, Accuracy and Reliability influenced the impact on respondent perception of efficiency of biometric cards (dependent variable) as a tool of E-Governance in the Sultanate of Oman. The hypothesis testing done through SEM proves that Efficiency is influenced by two factors -

Timeliness and Accuracy and both are statistically significant. Reliability was not found to have a significant impact on the perception of Omani citizens regarding the efficiency of biometric cards, thus indicating that integration of certain services especially regarding healthcare, education and enrolment for jobs with the biometric resident card is missing.This is in line with the research findings of Bwoma and Huang (2003) who identified integration of technologies between government agencies as a major obstacle in e-governance implementation.

Timeliness in Biometric identity card makes it easy to check criminal records, filing and pursuing civil and criminal cases, and enables timely and effective delivery of services. The Royal Oman Police launchedthe 'Yaqeen' project in 2015, which consolidates all biometric data the ROP holds to speed up crime-solving and enable better monitoring of suspects. As a result of better control the crime ratedropped by 15 per cent (www.planetbiometrics.com,2015).

Accuracy of output means biometric systems provide clear, precise and concise information; value of information generated by the deviceis one of the indicators to measure efficiency of Biometric Identity cards. All the five factors considered for measuring Accuracy have loaded well. It means the citizens feel that the biometric identity card is quite accurate in helping provide services to citizens. This is line with the findings of Choudrie, Ghinea, and Weerakkody (2004) who suggested that e-governance has the potential to improve external and internal relationships among the various stakeholders involved in the government services delivery process including citizens, government employees, external businesses and facilitate accurate and timely sharing of knowledge among these stakeholders. According to Ngugi, Kahn, and Tremaine (2011), accuracy of biometric technologies is not always fool proof but technology advancements have vastly increased the accuracy levels which in turn has made biometrics more acceptable to organizations and individuals. In 2017, the Sultanate of Oman introduced the Automated Biometric Identification System (ABIS) as a consolidated unified identification system which integrates with all biometric databases such as finger print, facial recognition, IRIS and DNA. The Automatic Biometric Identification System (ABIS) is aimed at enhancing public security. The platform is designed to execute biometric enrolment, identification and verification services across all government organizations. With full-fledged system implementation the present drawback of integration between different technologies between different government agencies would be resolved to a great extent.

6. CONCLUSION

The present study is done to investigate the role of biometric identity cards as an effective tool for E-Governance in the Sultanate of Oman as perceived by its citizens. The analysis reveals that the respondents have a positive perception about biometric identity cards in facilitating smoother and faster delivery of various services. Nevertheless, a few areas pose a challenge as far as implementation is concerned. The majority of citizens opined that interaction with government in the form of faster transactions, receipts and payments needs enhancement. Thus reliability of biometric card is an area requiring further improvement. There is a persistent feeling among citizens that government provided services lack integration and a single window system is needed to manage all the information at a central hub. Data are available with different departments and ministries but they need to be integrated using a common technology platform. This is in line with the findings of Al Busaidy and Weerakkodi (2011) as well as Oh, Lee, and Lee (2018). Overall most respondents perceive that the biometric identity cards have been instrumental in facilitating better governance of the country and making life easier for citizens.

The study has highlighted the crucial role played by digital technology and biometrics in enabling equitable, fair and speedy delivery of various services to Oman citizens. The findings show that biometric technology, despite its shortcomings, is a vital tool for government to ensure that its services are reliable, accurate and timely.

7. PRACTICAL IMPLICATIONS AND FUTURE DIRECTIONS

The present study is one of very few studies conducted in the Sultanate of Oman to understand the perceptions of citizens on efficiency of biometric cards as an E-Governance tool. Since E-Governance aims at using digital infrastructure and technology to ensure speedy and efficient service delivery to citizens, future studies should look into widening the ambit of biometric technology so as to integrate all the services and information in order to ensure better and faster servicedelivery. Some key areas identified for further improvement are using biometrics to prioritize health care delivery according to the urgency of patient's needs, ensuring better monitoring of pension services to senior citizens and upgrading the technology to red flag illegal immigrants and visa limit violators. Helping job seekers to find suitable jobs through employment exchanges is another area needing

good integration with the biometric system. The concerned authorities and government departments should take these into account while continuously upgrading the E-Governance infrastructure.

There is an abundance of scope for further research in this area. Researchers can investigate other factors and perspectives which affect implementation of E-Governance policies and structures in Oman. Several ministries are involved in implementing E-Governance strategy. Research can be conducted on successful implementation and integration of each ministry. Comparative studies between Oman and other GCC countries can be carried out to map the similarities and challenges in implementing E-Governance in different countries. The government can solicit the help of professional technology consultants to investigate grey areas in the present system and to suggest changes for ensuring robustness in future. E-Governance is indeed crucial to successful service delivery to citizens and biometric technology will play a wider and more important role in future.

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