

Government Data Governance and Management Frameworks Positive Collaborations, to Enhance Data Sharing and Efficiency of Government Services in Smart Cities

الأثر الإيجابي لتطوير إطار معايير حوكمة وإدارة البيانات الحكومية، لتعزيز تبادل البيانات ورفع كفاءة الخدمات في المدن الذكية

by

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Dissertation submitted in fulfilment

of the requirements for the degree of

MSc INFORMATION TECHNOLOGY MANAGEMENT

at

The British University in Dubai

November 2018

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Abstract

The conception of the word smart in smart cities; is often perceived, as cities that are aiming to improve its functions across various sectors, through the adoption of (smart) digital technologies. These cities value up the citizens prospective through services focused on innovation driven and data sharing; consequently, or in simple words embarking and enabling data sharing and offer smart services across the city.

Smart Governments globally (including United Arab Emirates) built on complex and diverse systems; aiming to change the way services are delivered and consumed. Government entities will have access to and hold a significant variety of data, however, only a subset of this, will be made available to share with other authorized entities or with the public, either because the rest is not relevant, or due to security restrictions preventing further dissemination. Therefore, Governments need to outline common processes to follow when contributing data,

This dissertation, through presenting a holistic review will cover three pillars, first pillar; is to highlight the gaps and challenges governments are facing on the backbone to a successful implementation for integration of government systems and services-, which is the Data. And that any data centric model strategy including the smart cities, should think of process not only technology when it comes to data.

Second pillar in this paper will elaborate on the components of data governance and data management, and the human resources needed in every government entity to adopt the data governance and support the transformation. Third pillar; will demonstrate the United Arab Emirates best practice, regarding issuing the data management and governance framework. In addition to two, real use case of integrated services, to show the coloration between having the proper data governance and the success of integrated services, maximizing the utilization of the technology and reduce the cost and time of fixing the data to fit to purpose.

I would like to focus that the smart/ digital cities need more integrated services; not more data.

ملخص

غالباً ما يُنظر إلى مفهوم كلمة "ذكية" في المدن الذكية على أنها مدن تهدف إلى تحسين وظائفها عبر مختلف القطاعات، من خلال اعتماد التقنيات الرقمية (الذكية)؛ هذه المدن تبنى على الأخذ بمنظور المواطنين بالاعتبار في كلّ ما تقوم به ، وذلك من خلال تقديم خدمات مبنية على الابتكار ومشاركة البيانات ؛ وبالتالي ، أو بكلمات بسيطة تمكين مشاركة البيانات لتقديم الخدمات الذكية في جميع أنحاء المدينة.

الحكومات الذكية عالمياً (بما في ذلك الإمارات العربية المتحدة) مبنية على أنظمة تقنية معقدة ومتنوعة؛ تهدف إلى تغيير طريقة تقديم الخدمات والاستفادة منها. يتوفر لدى الجهات الحكومية إمكانية الوصول إلى مجموعة كبيرة من البيانات والاحتفاظ بها، ومع ذلك، سيتم توفير مجموعة فرعية فقط من هذه، للمشاركة مع الجهات المعتمدة الأخرى أو مع العامة، وذلك لأن لبيانات الأخرى ليست ذات صلة، أو بسبب قيود السرية في تصنيف البينات. وعليه، تحتاج الحكومات إلى تحدير المشتركة التي يمكن اتباعها عند المساهمة بالبيانات.

تتناول هذه الرسالة ثلاثة محاور رئيسية، وهي أولاً تسليط الضوء على الثغرات والتحديات التي تواجهها الحكومات في أهم العناصر الممكنة لعملية ريط الأنظمة وتكامل الخدمات الحكومية -وهي البيانات، وذلك من خلال تقديم مر اجعة شاملة تثبت أن أي استر اتيجية نموذجية تتمحور حول البيانات بما في ذلك المدن الذكية، تحتم على الحكومات إرساء بيئة مناسبة لتبادل البيانات بكفاءة بهدف توجيه سلسلة قيمة البيانات وعدم التركيز على الجوانب التقنية فقط.

ثانياً، سنسلط الضوء على مكونات حوكمة البيانات وإدارتها، والموارد البشرية اللازمة في كل جهة حكومية لتبني حوكمة البيانات ودعم التحول. ثالثاً، سيتم توضيح تجربة دولة الإمارات العربية بتطبيق إطار عمل البيانات، وتطبيقها كتجربة ناجحة على خدمتين متكاملتين، تثبت وجود علاقة طردية بين الإدارة الصحيحة للبيانات ونجاح الخدمات المتكاملة، مما يزيد من الاستفادة من التقنيات وتقليل التكلفة والوقت عبر توفير بيانات متناسبة مع الغرض.

سيتم التركيز على أن المدن الذكية / الرقمية تحتاج إلى خدمات أكثر تكاملاً؛ وليس المزيد من البيانات.

Keywords United Arab Emirates; Smart Cities; Data Governance, Smart Government, Digital Government, Data, Integrated Services, etransformation, Data Quality, Data governance, Data Management, Data governance Roles

Acknowledgement

I am deeply grateful to **Professor. Khaled Shaalan** for his infinite supports, valuable advice and guidance. Special thanks and appreciations for **Professor. Sherief Abdallah** who taught me different modules during my study. I would like to express my sincere gratitude to my sister Sarah Hamdan and my friends, Ms. Ragia Abdalwahab and Ms. Nesreen Safa **for** the continuous support during my study time.

Finally, all my deepest gratitude for my mother and my dear husband Ayman Abu Hasna for his unlimited support, and my adorable kids Zaid & Talya ...Thanks for all.

Table of Contents

Contents

Abstract	•••••
Chapter One: Introduction	1
1.1 Overview	1
1.2 Problem Definition	1
1.3 Research Motivation	2
1.4 Research Purpose	2
1.5 Research Questions	3
1.6 Research Methodology	3
1.6.1 Planning the Review	4
1.6.2 Identification of Research	4
1.6.3 Selection of primary studies	5
1.6.4 Systematic Review Synthesis	5
1.6.5 Systematic Review Results	6
1.7 Dissertation outline	6
Chapter Two: Literature Review	8
2.1 Overview	8
2.2 Introduction	8
2.3 Data, Information and knowledge	9
2.3 Big Data	10
2.4 Data Governance & Data Management	12
2.5 Data Governance & Management Roles	14
2.5 Data Quality Dimensions	15
2.6 Chapter Two Summary	18
Chapter Three: Systematic Review	19
3.1 Overview	19
3.2 Introduction	20
3.3 Smart Government & Smart Cities Data Sharing Challenges	20
3.4 Effective Government Data Governance Framework	23
3.5 Data Governance/ Management Framework Components, scope, aspects and domains	25
3.6 Chapter Three Summary	28
Chapter Four: Use Case and Proof of Concept	29
United Arab Emirates National Smart Data Framework	29
(Best Practice Use case)	29
4.1 Use Case Background and Overview	29

4.2 UAE National Smart Data Framework Components, scope, aspects and domains	31
4.3 UAE National Smart Data Framework Goals and Benefits	32
4.4 UAE National Smart Data Framework Structure	
4.5 UAE National Smart Data Framework Principles & Imperatives	35
4.6 UAE National Smart Data Framework Governance	
4.6.2 Establish governance relationships and processes	
4.6.3 Capacity Building	40
4.6.4 Organize and facilitate regular consultations, workshops and reviews	40
4.6.5 Continuous improvement	40
4.8 UAE National Smart Data Framework Implementation Obstacles, Challenges	42
Chapter Five: Discussion and Limitations	46
Chapter Six: Conclusion and Future Work	
References	51
Appendix A – Glossary	53
Appendix B – Data Inventory and Catalogue Sample Template	57

Table of Figures

Figure 1 Business and Government Data Attribute Compared [31] (Kim, 2015)	22
Figure 2Data as a priority area in the UAE National Plan.	39
Figure 3 Data Standards Domains in the UAE Smart Data Framework	40
Figure 4UAE National Smart Data Framework Benefit	41
Figure 5 UAE National Smart Data Framework Structure	43
Figure 6 UAE Smart Data Management Framework Implementation Guide Components	44
Figure 7UAE National Smart Data Framework Principles	46
Figure 8 UAE National Smart Data Governance Roles- on the entity Level	47
Figure 9 UAE Smart Data Framework Implementation recommended process	50
Figure 10 UAE Data Framework Project implementation phases	52
Figure 11 International Best Data Management practices referenced	53
Figure 17 Artificial Intelligence adoption coloration with saving 50% of the overall expenditure	54
Figure 19 Data Inventory Template	65
Figure 20 Data Inventory Sample Template	66

Chapter One: Introduction

1.1 Overview

This chapter will define the problem definition of this research; in addition to the elaboration on the research, motivations and purpose. Moreover, a brief will state the systematic review conducted in this dissertation in regards to the research questions set and methodology of execution. Finally, the last section in this chapter will identify the dissertation outline, describing the following chapter's structure and description.

1.2 Problem Definition

Governments are complex networks of systems that often work in silos but also interact with each other to deliver services. The interconnectedness of these systems unlocks the value of Smart city concept.

Governments are experiencing the pressures of population growth, especially in urbanized areas, which will put extensive pressure on the government's infrastructure and services. Key challenges facing the governments is the collaboration on sharing data among government entities in a safe, secure, and reliable way, and encouraging participation across stakeholders to change the way services are delivered and consumed.

During my work in the Smart Government sector in the United Arab Emirates; for more than 10 years, I had the chance to oversee several initiatives as part of the UAE eTransformation strategy towards a digital government. Vital to the success of these initiatives is to fulfil the need to break the silo structure between governments to collaborate in the integrated solutions and services for a sustainable approach to operating a smart city.

This dissertation, will analyze the problem of government's data collaboration through proofing that a proper data governance addressing the minimum requirements of components and domains of the data governance, along with the human recourse capability needed in each government entity to provide data is fit to purpose and increase services efficiency.

1.3 Research Motivation

Through better use of information and communications and appropriate data governance and management framework, governments have the potential to leverage acquired data and information to envision personalizing data sharing to become more efficient and less costly, providing value-added savings in the areas of data sharing, integration, and management

Successful data governance framework has a profound influence on the effectiveness of any Government, a consistent approach will enable the smooth flow of data across Government Entities; by creating a common set of standards, and a governance platform upon which each entity can develop an understanding of all of the data assets available across the government as a whole.

The Data Management & Governance framework is meant to set the guidelines and standards for government entities to be able to conduct data inventory and catalogue, maintaining data quality, formatting of data for interoperability, metadata usage and management of Information lifecycle management and ensure Data security by the proper classification of the data sets.

1.4 Research Purpose

In the last two decades, the leading Smart Cities globally were developing a data centric strategies and guidelines to fulfil the smart cities needs and objectives; focusing on services efficiency and effectiveness.

Therefore, this dissertation, aims to proof through a background literature review along with a specify systematic review, international best practices and revealing a proven use case; how the development of an appropriate data governance and management framework, for governments shared and published data; will enhance the integration of government services.

In addition, strengthen the government's efforts to transform into an intelligent interconnected government and increasing services and customers satisfaction.

1.5 Research Questions

A general background literature review in addition to systematic review were conducted on data governance and management frameworks and its coloration with enhancing the integrated services smart cities are offering to consequently, improve the effective and efficacy of the services reduce cost and increase customer's satisfaction.

The goal is to provide an overview of the researches studies, concepts and main findings of governments data sharing challenges; current frameworks globally and data management framework scope, components and domains. Therefore, specifically the below questions were addressed, related to the below areas:

- > What are the Smart Cities and smart government's data sharing challenges?
- > What are governments doing in regard to Data Governance/Management Framework?
- What should the Data Governance/Management Framework components, scope, aspects and domains be?

1.6 Research Methodology

The research methodology involved assessing the data sharing collaboration, in terms of benefits, gaps and challenges within governments. Furthermore, review some of the best practices with respect to the data governance and data management were recognized and covered. Likewise, the

focus was on the governments Data governance components and capabilities of human recourses, needed to support the integrated government's services, data hubs and achieve the smart cities objectives.

The systematic review commenced by developing a protocol, to specify initially the method used to answer the survey questions. The protocol included setting review questions, the research methodology, in addition to the criteria used for the inclusion and exclusion of papers, and the synthesis. The purpose of this systematic review to answer the questions listed in section 1.5 above.

1.6.1 Planning the Review

The systematic review commenced by developing a protocol, to initially specify the method used to answer the survey questions. The protocol included a setting a review questions, the research methodology, in addition to the criteria used for the inclusion and exclusion of papers, and the synthesis. The purpose of this systematic review to answer the questions listed in section 1.5 above.

1.6.2 Identification of Research

The search keywords used was in the generic search terms; to assist identifying related papers; keywords used as listed in Table 1 below:

ata	Cities
Government	analytics
ial Intelligence	Ianagement
Discovery	tandardization
nterpretability	ixchange
nment Data	Services
I Transactions	rnment
ated Government	ated Government Services
egislations	Centric Government
nment Services Efficiency	nment Customer Satisfaction
Juality	
Table 1 Counch Vermonda	

Table 1 Search Keywords

Google scholar, Gartner and international best practices Data Management Frameworks databases were the main source of papers and researches reviewed.

The initial overview on the above keywords resulted in 187 relevant papers and articles.

1.6.3 Selection of primary studies

A refinement process to eliminate the non-relevant and duplicate papers; which resulted with 77 papers were considered for the second round of refinement process.

A thorough reading of the 77 papers abstract and conclusion was led, similarly another round of refinement process was done to exclude papers that was not focusing data management frameworks, or which referred to data management frameworks developed for certain technical platforms were eliminated.

After the exclusion of the unreverent and duplicate papers, a list of 33 short-listed papers were reviewed methodically.

By following this formal method with explicit inclusion and exclusion criteria, the intention was to provide a research review with minimal bias arising from 33 papers.

1.6.4 Systematic Review Synthesis

The 33 papers were reviewed to extract the below; to find answers to our research questions.

- Main Finding
- Man Concepts
- Research methods

1.6.5 Systematic Review Results

The research and revision of the shortlisted papers tackled the below areas:

- > Question One: What are Smart Cities and Smart government data sharing challenges?
- Question Two: What are governments doing in regard to Data Governance/Management Framework?
- Question Three: What should the Data Governance /Data Management Frameworks components, scope, aspects and domains be?

1.7 Dissertation outline

The dissertation structure were divided on six chapters, as follows:

Chapter 1: Introduces the background overview along with the description of the chapter sections on the problem definition, research motivations, and objective, systematic review research questions. Additionally, to the research methodology employed.

Chapter 2: A general background literature review, elaborated on the basis and useful information related to data governance and management frameworks. Starting by defining what is data, the concept of big data, assessing the importance of government data governance and management frameworks and declaring the human resources responsibilities and roles needed in every government, and discussing the data quality and its dimensions. Summarizing the chapter with the main findings within the summary section.

Chapter 3: This chapter extensively discusses the research questions evaluated in the systematic review, pointing out the findings and concepts found through the research, to support the aim of this dissertation, which is the positive coloration between data governance and management

frameworks and enhancing government data sharing to increase the efficiency of smart cities and support the integrated service.

Chapter 4: In this chapter, the United Arab Emirates National Smart Data Framework broad overview chosen as a best practice use case. Other than stating the main components of the framework and the rational on its need; an elaboration on two services; based on standardizing data sets shared through various governments; is the proof of concept of the successes of the data frameworks, emphasizing on the benefits the UAE government achieved when they integrate their services.

Chapter 5: In this chapter, a discussion on dissertation topic and list the limitations throughout the research implementation.

Chapter 6: In this chapter, the conclusion on the main dissertation findings, and the, in addition to the future work that may be carried out for future research.

Chapter Two: Literature Review

2.1 Overview

This Chapter will include a literature review on the background and description of the terms used in this dissertation, while the introduction displays what are the smart cities, smart governments and their need to collaborate on sharing data. The following sections addresses in brief the review on the what is data, big data, data governance, data management, data quality, data governance roles needed.

Tackling the above-mentioned subjects in the below sections of chapter two will set the background in order to set the rational on the systematic review conducted in chapter three.

2.2 Introduction

To start with, we will refer to Gartner to define the Smart City as "a city is based on intelligent interactions of data and information which flow between its many different subsystems. This flow of information is analyzed and translated into citizen and commercial services. The city will act on this information flow to make its wider ecosystem more resource efficient and sustainable. The information exchange is based on a smart governance operating framework designed to make cities sustainable."[2][Gartner, 2011]

Behind every Smart City, there is Smart Government program or entity leading several initiatives on the city level. Reference to Anthpoulas; in his The Rise of the Smart City publication, a "Smart Government" is an innovative government that uses ICT and data in addition to other means to improve quality of life, effectiveness of operation, and efficiency of services, and competitiveness. In Parallel, ensuring that it meets the needs of present and future generations with respect to economic, social and environmental aspects .[1](Anthopoulos, 2017).

As stated in the above two definitions of the Smart City and Smart government; we can clearly pinpointed the importance of the collaboration between governments data sharing to ensure the success and fulfilment of Smart governments efficiency, effectiveness transparency and ensure stakeholder along with public engagement to exceed the customers' expectations.

Government data due to its characteristics; is considered Big Data; which we can summarize as collecting and processing very high volume of data with large rapidity and diversity of data being generated from different sources. Additionally, it includes the associated systems and algorithms used to analyze these massive datasets. [3](K.2017) [4](F. 2012)

It is important to study the data governance and data management best practices in terms of its discovery, accessibility, protection, data sharing and reuse. Data sharing identified in the 21st century as a valuable part of the scientific method and considered as the infrastructure of science. Moreover, "science is becoming data intensive and collaborative".[6] (Tenopir 2011)

It is worth mentioning that MK solutions proposed to develop a sophisticated catalogue, with having data policies and licenses — as well as the data flows that relate to them so data can be represented as machine-readable format. This, in turn, enables the implementation of complex inference rules to support the automatic manipulation of such information in tasks, such as data discovery and policy validation. [5](d'Aquin 2015)

2.3 Data, Information and knowledge

Data is the representation of facts as texts, numbers, graphics, images, sound or video, data is the raw material, which is used to create information, therefore the facts that are captured and stored and expressed is data.

There is no worth or meaning of the data by itself, in its raw format; it can be in any form, usable or not. [30]

Information on the other hand, is data in context; hence, without context, data is meaningless we create meaningful information by interpreting the context around data, so when data is presented in the proper context it will in a form suitable for interpretation.

Data that has been given a meaning through a relational connection is considered information, in computer parlance, the stored data can make information when in it's in a database [30]

Understanding the significance of information is Knowledge, basically it's the insights into appropriate actions based on interpreted data, henceforth it's about of information, and consequently enabling effective action.

Knowledge is a deterministic process; the appropriate collection of information, such that it is intent is to be useful. [30]

The government's structure must be capable of managing the information throughout its life cycle — regardless of source or format (data, paper documents, electronic documents, audio, video, etc.).

2.3 Big Data

Today we live surrounded by Big Data, the digital era has one dominant characteristic; the produced data and information these days are tremendous. [32] (Stolic, S. 2015)

According Kim, G.H., Trimi, S. and Chung, in there paper Big-data applications in the government in the year 2014; the attributes and challenges of big data are defined in data volume, velocity, and variety. The Data size and volume is the primary attribute, while velocity refers to the speed data is generated, processed and delivered, that is, big data is so large and difficult to manage ; while the Variety of that data is where the data is coming from in which form, such as structured ; semi-structured (like a database); and unstructured (unorganized data). [31] (Kim, 2014)

Governments as any organization are dealing with general issues of big-data integration from multiple sources and in different formats, in addition to high costs of processing the data. However, governments deal with data that not only comes from different sources as the web, social networks and crowd sourcing, but from other diverse sources (such as countries, institutions, agencies, and departments). Sharing data and information between them is the distinct challenge. [31] (Kim, 2014)

Governments expect big data to enhance their capability to serve their citizens and address major challenges in various sectors; therefore, most of the government initiatives in developed cities are appears to share structured databases of stored data; to deal with the large and complex datasets. [31] (Kim, 2014)



Figure 1 Business and Government Data Attribute Compared [31] (Kim, 2015)

2.4 Data Governance & Data Management

Data governance stipulates the framework of decision rights and responsibilities in regards to required activities and performance of the data use. [25] K Wende 2007

The management of data to capture structured and unstructured data; in the last decade, both the business and IT professional in all sectors agrees on the perspective that data is a valuable resource in any organization. Considering data as corporate assets; implies the importance of data governance and data management. [27]

Griffin J (2005) said that data governance is the process of managing data in terms of its quality, consistency, usability, security and availability, highlighting that data governance should be a part of the corporate culture; by developing data standards across the organization. [29] (Griffin J 2005)

Practitioners along with researches and data scientists agrees according to *Otto, Boris 2011,* that data governance is fundamentally regarding assigning decision rights and responsibilities for data management activities in any organization; this is a promising approach to preserve the data quality. [28] (Ottp Borris 2011)

Cheong, L. K., & Chang, V. (2007) (The need for data governance: a case study); stated that there are top ten serious factors for the success of data governance, are the below:

- Strategic Accountability and accountability, which means that the leadership executives need to drive the governance process, however to implement a successful data governance the roles and responsibilities for various people in the organizations who are involved in the data governance process need to be clearly defined.
- The need to have data standards is vital, as the data needs to be defined and 'fit for purpose'.
- The Alignment of business objectives with data specific technology, process and organization bodies.
- Embracing complexity meaning that the stakeholder data management is complex, as data could be after collection enriched, distributed, consumed and maintained by different data stakeholders.
- Data governance structure should be cross-divisional, from all level of the organization to support data quality.
- Data governance success, quality metrics, and KPI are important for measuring performance.
- When organizations shares data with other organizations (partner), the data quality requirement should be agreed on from both organizations, there each organization should be accountable of its data.
- Controls need to set to determine when and where quality of the data is to be assessed.
- Periodic assessment and evaluation of the data management procedures and polices has to be done, in order to ensure that its being are being followed.
- Data stakeholders need to realize the significance of data governance and data quality [28] (Cheong, L., 2007)

2.5 Data Governance & Management Roles

Weber K 2009, in his article One Size does not fit all- A Contingency, specified four data quality roles, which are from both business and IT departments professionals, they are executive sponsor, chief steward, business data steward, and technical data. [26] (Weber K 2009)

Government entities may benefit from having a competencies roles and responsibilities RACI matrix; for their data governance and data managements roles and responsibilities. The consistent framework will describe 'what good looks like' for Chief Data Officers, Data Stewards, Data Management Administrators – and all staff using data; it will provide accountability, clarity about how they need to work, manage skills gaps and have a personal development framework for the related employees.

It is worth mentioning that in smart cities scenarios, there will be two different sets of roles, responsibilities needed, one for each government entity, and the other is for the governing body in charge of implementing the smart government program.

The Five key roles for managing data within Government Entities are:

- Chief Data Officer
- Data Management Administrator
- Data Steward
- Data Expert
- Data Specialist

However, for the entity leading the smart government programs and initiatives, in addition to the above the below roles and responsibilities will be needed:

- Policy: Setting the framework expertise
- Compliance: Ensuring compliance and capability by Data Providers
- Enablement: Exploiting data to deliver /such as data scientist

2.5 Data Quality Dimensions

In reference to the ISO 9000:2015 the definition of quality is the degree to which a set of characteristics of data fulfills requirements

Data quality management (DQM) is a part of Data governance, it is a module to fulfil and address the challenges any organizations or governments is facing in relation to Data Quality. This will include technical and business perceptions, however most of the organizations anticipated that this an IT department role, although in reality it is a combination of business and IT roles. [25] (K Wende 2007)

The data characteristics needs to be well adjusted; with the importance and the intended use of the data concerned. Data; may be considered 'fit for purpose' even if not all characteristics are sacrificed. For example, less accurate data; may be collected in order to provide data that is timely if this is a priority.

Data quality describes the degree to which a set of inherent characteristics fulfils requirements. Data; should be measured, monitored and managed. In order, data to ensure sufficient to support its intended use and that allows users of the data rely upon it to support informed decisionmaking.

Moreover, data quality concept is needed to be able to keep track of value, relevance and severity of the data, to maximize the impact of the aforementioned preprocessing transformations. Several dimensions of data quality are set to be able to measure and manage the data accordingly; the data quality dimension offers a way to measure and manage data quality. [33]

Through the literature review and the international best practices publications and papers such as the ISO and DAMA; the data quality dimensions are associated based on the business context, requirements, levels of risk and other factors in the entity. Therefore, each dimension is likely to have a different weighting and in order to obtain an accurate measure of the quality of data.

15

The able below demonstrates the most common data quality dimensions:

Data	Description		
Dimension			
Accuracy	Data should be sufficiently accurate for the intended use; therefore, it should be captured only once at the point of activity. Although it may have multiple uses. Accuracy is the degree to which data correctly reflects the real world object OR an event being described		
Validity	including the correct application of any rules or definitions. This will ensure consistency between periods and with similar organisations, measuring what is time intended to be measured.		
Integrity	Integrity means validity of data across the relationships and ensures that all data are in a database can be traced and connected to other data.		
Reliability	Data should reflect stable and consistent data collection Processes across collection points and over time. Progress toward performance targets should reflect real changes rather than variations in data collection approaches or methods.		
Precision	Data should have a sufficient level of detail to present a fair picture of performance and enable management decision making." For a data set to be "precise," relevant data; should also be collected by the designated disaggregation characteristics, such as age, and geographic location.		
Timeliness	Data; should be captured as quickly as possible after the event or activity and must be available for the intended use within a reasonable time-period. Data must be available quickly and frequently enough to support information needs and to influence service or management decisions.		
	needed. Timeliness of data is very important and depends on user expectation		
Relevance	Data captured should be relevant to the purposes for which it is to be used. This will require a periodic review of requirements to reflect changing needs.		
Completeness	Data requirements; should be clearly specified based on the information needs of the organisation and data collection processes matched to these requirements.		
	Completeness; is defined as expected comprehensiveness. Data can be		
	complete even if optional data is missing. As long as the data meets the		
	expectations then the data; is considered complete.		

Table 2 Data Quality Proposed Dimensions

Although the above tale demonstrates most of common data dimensions; the below table 3 presents the extra dimensions to be considered according to the entities data requirements:

Data	Description	
Dimension		
Conformity	Conformity means the data is following the set of standard data definitions like data type, size and format.	
Readability	Readability; is defined as the ability of data content appropriately presented and to be correctly explained according to known or well-defined terms, attributes, units, codes, abbreviations, or other information.	
Consistency	Consistency across data sources means data across all systems reflects the same information and are in sync when data is shared.	
Credibility	Credibility; is used to evaluate non-numeric data. It refers to the objective and subjective components of the believability of a source or message. Credibility of data has three key factors: reliability of data sources, data normalization, and the time when the data are produced	
Metadata	With the increase of data sources and data types, because data consumers distort the meaning of common terminology and concepts of data, using data may bring risks. Therefore, data producers need to provide metadata describing different aspects of the datasets to reduce the problems caused by misunderstanding or inconsistencies	
Structure	More than 80% of all data is unstructured, therefore, structure refers to the level of difficulty in transforming semi-structured or unstructured data to structured data through technology	
Accessibility	Accessibility refers to the difficulty level for users to obtain data. Accessibility is closely linked with data openness, the higher the data openness degree, the more data types obtained, and the higher the degree of accessibility.	

Table 3 Additional dimensions of Data Quality

2.6 Chapter Two Summary

In this chapter, we reviewed the concepts and findings on the related basis for data governance and data management, starting by the explaining in the overview the reason we are conducting the literature review in chapter two; and consequently the systematic review in the following chapter three.

We can summarize that government data considered big data due to its complexity, velocity and various sources of data multiple sources and in different formats. Government's structure must be capable of managing the information throughout its life cycle.

Moreover, governments expect big data to enhance their capability to serve their citizens and address major challenges in various sectors. Ten success factors for data governance was identified as Strategic Accountability and accountability, Data standards need, alignment of business and technical objectives, embracing complexity, cross divisional governance structure, Partnership data quality, measurements for assessing data quality to fit to purpose, assessing the control and Periodic assessment and evaluation of the data management procedures and polices

Both business and IT department's professionals are need to fulfil the objectives of data governance; mainly the roles are executive sponsor, chief steward, business data steward, and technical data.

Due to the importance of Data Quality, we stated the dimensions of data quality as per the international best practices, these domains are accuracy, validity, integrity, reliability, precision, timeliness, relevance, completeness

Data quality concept are needed to be able to keep track of value, relevance, and severity of the data, to maximize the impact of the aforementioned preprocessing transformations

Data; is identified as a key enabler for government initiatives and services, and one of the main requirement for Smart Government programs, hence the data governance and data management are vital to cope with the big data and smart cities era.

18

Chapter Three: Systematic Review

3.1 Overview

- In this chapter, the methodology of the systematic review mentioned in section 1.6 has been conducted, A set of articulated question were chosen to be analyzed through the systematic review methods identified, therefore; a collection of select papers and studies relevant to the dissertation topic was analyzed.
- I will elaborate on the main finding of the research and revision of the shortlisted papers to answer the systematic review research questions. A total of 33 published papers and studies along the last fifteen years were considered, however concentrating on the most recent once; for carrying out a systematic review and analysis:
 - > What are Smart Cities and Smart government data sharing challenges?
 - What are governments doing in regard to Data Governance/Management Frameworks and Strategies?
 - What should the Data Management Framework components, scope, aspects and domains be?

Each question will be presented in a separate section; demonstrating the main finding and approaches.

3.2 Introduction

Data was identified as a key enabler for government initiatives and services, and one of the main requirement for Smart Government programs; hence key challenges facing governments; is collaboration on data sharing, among government entities in a safe, secure, and reliable way, and encouraging participation across stakeholders; all with the goal of changing the way services are delivered and consumed.

Deliver one-stop end-to-end services that meet peoples' expectations, is one of the objectives of smart governments, this; will not be accomplished if the data was not shared among different government entities.

Although many governments; through there integrated systems, shared data to fulfil automating and integrating smart service, however the data quality variance caused a complicity in the processes to map the data, in addition to negatively effecting the service overall efficiency and accuracy.

3.3 Smart Government & Smart Cities Data Sharing Challenges

This section, will answer the first question set for the systematic review, which tackles the challenges Smart Cities and Smart governments are facing in regards to data sharing.

Several studies and surveys conducted to identify the challenges of smart cities and smart governments regarding the data sharing.

Most of Smart Governments through their journey of transformation, started with creating applications and systems to act a centralized data lakes (Warehouses); however as perfect as theses data lakes might sound; as the ultimate solution, several issues was identified related to data integration, data size, and data variety of sources; which reflected to the complexity of

Transforming the data to the appropriate format for the data infrastructure and the curation effort of such centralized methods becomes unsustainable. [5]

Data security and privacy breaks are one of the most debatable issues when it comes to data sharing; it's a vital concern, in government for the citizen data; when its stored in data lakes [10] (Hoffman & Podgurski, 2013).

The need to provide a timely data, with real time value is another challenge facing government entities when they want share the data; Smart cities are built on accurate real time data. Hence, Kitchin, R mentioned in his research *The real-time city*, raised several concerns and obstacles to having a real-time city, which mainly focused on the data policies for the big urban data, such as; the technocratic governance and city development; The corporatization of city governance and the technological lock-in; [7] (Kitchen R. 2014)

Even though there are numerous government data governance frameworks initiatives, setbacks are preventing them from reaching their full potential, the challenges vary in there aspect and domain according to *Attard*, however they are mostly barriers of a technical nature, with common challenges in the usability, reusability and data accessibility of data; in addition to the legal and political issues. [9] (Attard 2015)

The below table 4 reveals the main challenges Smart Government and Smart Cities are facing regarding to the Data sharing; responding the areas of this review set in the first section of this dissertation:

> What are Smart Cities and Smart government data sharing challenges?

pt/ Challenge	Finding	nce
Data Privacy &Security	Big data introduces challenges to personal privacy, systems complexity and over expectations of customers.	11][12]
nteroperability	When Data interoperability and harmonization are recognized, it reflects positively on the ability to; interpret and effectively exchange; and share data, through achieved through shared terminologies, and coding.	
nation management issues	Information management issues; can be classified into more than ten dimensions and categorized in one of 3 categories: quantification, access and quality assurance.	
nance & Legislations	Governing the data and the related legislations; are pointed out as a solution to enhance data sharing. Hence, some legislations might need to be reviewed and a proper governance will make the data exchange more efficient; however the existing legislations and standards across the various sectors may be considered as a challenge for the data governance to be able to align with all sectors.	
me data	Data governance policies can overcome the setback of sharing outdated; and prompting the governments to provide real time data to have a real time city, through the technocratic governance and lock in. however, the maturity level of governments may vary, and that might put a pressure and challenge for them to provide real time data when needed.	
ne of the data	Currently all organizations focus only on the volume of data, and they are discarding all other challenges. The volume of data introduces challenges to personal privacy, systems complexity and over expectations of customers.	2]
Data Management	The need for information sharing, will exponentially increase the need for metadata management capability in organizations, Not having the right metadata is a major challenge in data sharing.]
Accessibility	Data accessibility principle determines that data needs to be accessible to those who have a legitimate and have a reason to use it, at the time needed. This access; should be enabled over proper	

	controls. Accessibility is defined as a challenge in	
	data sharing	
Table 4 Concepts and main findings for 01		

 Table 4 Concepts and main findings for Q1

3.4 Effective Government Data Governance Framework

Optimizing current investments in traditional business intelligence, data warehousing, and enterprise data management, increased the necessity for developing strategies to harness the power of the government data and information; thus data governance framework and related strategies, ensure long-term innovation leadership, and addresses challenges to attain objectives of smart cities.

The demand for a set of data and information management approaches, architectures, and data science disciplines has never been more critical. The 'new style of IT' requires a review of how data and information management and analytics can support the government data Governance framework and strategies, to break through the government data gridlock and quick deployment for contributing in increase the efficiency and effectiveness of government services.

Overall, the proper data governance framework; will provide a structure, standards and mechanisms for defining data and information exchanges between and within various government entities and domains.

Each government entity or department typically has its own warehouse in silo of confidential or public data and information. Most of these government entities are often reluctant to share what might be considered proprietary data. In addition, some data; are governed by certain privacy conditions that make it hard to share with other entities.

The below table 5; displays some of existing government's data governance framework and strategies; responding the areas of this review set in 1.6 of this paper:

> What are governments doing regarding Data Governance Framework and Strategies?

pt	Finding	nce
al Agenda for	In 2012, in its "Digital Agenda for Europe and	
Europe"- European	Challenges for 2012,". The European	
Union	Commission made big data strategy part of the	
	effort, emphasizing the economic potential of	
	public data locked in filing cabinets and data	
	centers of public agencies; ensuring data	
	protection and increasing individuals' trust;	
	developing the Internet of things, or	
	communication between devices without direct	
	human intervention; and assuring Internet	
	security and secure treatment of data and online	
	exchanges.	
al ICT Strategies-	1; the Big Data Initiative, launched for National	
South Korea	ICT Strategies, aimed to converge knowledge	
	and administrative analytics through big data.	
ata Controls	Governments can adopt the top-down approach	
	to manage and integrate big data. Through	
	establishing big-data control to integrate	
	accumulated datasets, structured or	
	unstructured, from departmental silos.	
ata Management	For proper and useful utilization of government	
	data in smart city applications, there should be	
	effective and appropriate big data management	
	tools, which includes development, execution	
	and monitoring of architectures, policies,	
	practices and procedures to manage effectively	
	the lifecycle of the data required during its use	
	in smart city applications.	
Government Role	Smart cities should have a governing entity to	.4]
	establish principles to guide the transparency,	
	participation, openness, and collaboration to	
	ensue data sharing and exchange is controlled	
	Moreover, governments need to establish an	
	advanced government entity responsible for	

	developing strategies for data management ,through new technology platforms and analytics and how to secure skilled professional staff.	
/lanagement International, DAMA	DMBOK defined data management as developing, execution and supervision of plans, policies, programs and practices that control, protect, deliver and enhance the value of data and information assets The DAMA Standards are internationally recognized and implemented in several governments globally.	
Data Handbook/ France	overnment of France has developed a Government Open Data Handbook that details guidelines on good practices for publishing and reuse of government data. In addition, the document has been tailored to the needs of different ministries by highlighting examples of data that can be released by specific ministries.	lished source, Benchmark on Smart Data strategies by Deloitte
ustralian Public Service Big Data Strategy	ved understanding through enhanced data- analytics capability - August 2013: the strategy aims to assist agencies in achieving productivity gains, through better service delivery and policy development while ensuring the privacy of individuals remains protected	lished source, Benchmark in Smart Data strategies by Deloitte
K Open Data White Paper shing the Potential	shing the Potential - June 2012: Transparency is at the heart of the government agenda; opening up will empower citizens, foster innovation and reform public services	www.official- documents.gov.uk/

 Table 5 Concepts and main findings in Q2

3.5 Data Governance/ Management Framework Components, scope, aspects and domains

Reference to the above section, we realize the need to have data governance frameworks and strategies to be governed by a governing body in the government to ensure data sharing across various government entities. These frameworks should develop all the necessary standards to define and regulate the end-to-end procedure for data sharing and publishing across entities. The Data need to be; accessed, understood, and adjusted to existing data integration practices and to the on growing maturity of other Smart Data initiatives.

The data governance frameworks should consist of technical specifications that standardize data management practices and implementation of technologies and designs to improve the effectiveness of data handling, data sharing, and interoperability across all Smart Government initiatives by providing common data-related design and implementation guidance.

The data governance framework, will support the creation of an efficient environment, provide the necessary guidelines to produce high quality, reliable, and interoperable data sets, and promote its adoption. Nevertheless, the question that pops up, what exactly should the scope, components aspects, and domain be?

The data governance and management framework and its related procedures will instruct government entities what data or information they can and should share. [15](Allen 2015). The data governance include guiding principles of quality of data sets, data sets security and protection, and the data management throughout the entire data sharing value chain.

The below table 6, demonstrates the main concepts on the scopes, aspects and domains of the Data Governance Framework; responding the areas of this review set in the section 1.6 of this dissertation:

What should the Data Governance/Management Framework Components, Scope, aspects and domains be?

spect/ domain to be	Finding/ aspect or domain definition and description	nces
included in Data		
Frameworks		
ning and Governance	Sovernance in Data Management are divided in 2	7][18]
Concept	aspects:	
	- Governance body, which meant as the entity	
	to govern the Data Governance,	
	Management Policies and frameworks.	

 Table 6: Concepts and main findings for Q3

3.6 Chapter Three Summary

Consequently, governments are encouraged to provide support in creating an efficient data governance and management frameworks environment, providing the necessary guidelines to produce high-quality, reliable, and interoperable data sets, and to promote the framework adoption.through provide the necessary guidelines to produce high-quality, reliable, and interoperable data sets, and to promote its adoption.

Successful data governance framework has a profound influence on the effectiveness of any Government, a consistent approach will enable the smooth flow of data across Government Entities; by creating a common set of standards, and a governance platform upon which each entity can develop an understanding of all of the data assets available across the government as a whole.

Chapter Four: Use Case and Proof of Concept United Arab Emirates National Smart Data Framework (Best Practice Use case)

4.1 Use Case Background and Overview

- In May 2013, the United Arab Emirates launched of the Smart Government initiative (program), aiming to improve government services continuously in terms of quality and delivery to build citizen and constituent satisfaction and ensure the country continues to be a global leader and innovator in digital government.
- UAE Smart Government accordingly announced several nationwide initiatives; grouped in one program, which is called UAE National plan; this program included seven priority areas; and 22 initiatives; that will enable and support the government's overall transformation.

One of the seven priority areas in the national plan was the Smart Data; due to the importance of having accurate and high-quality data to envision the success of all initiatives of National plan, the Smart data propriety area included three sub initiatives, which are the National Smart Data Standards Frameworks, Smart Data system, and the Smart Data analytics.

Accordingly, in 2015, The Smart Data Strategy was developed with a 5 years implementation road map, were the National Smart Data Standards (The Data Governance and Management Framework of the UAE) was one of the projects outcome of that strategy.

The UAE Smart Data Standards initiative is an essential part the UAE Smart Government National Plan. It envisions personalizing Smart Government for smart data sharing to become more efficient and less costly, providing value-added savings in the areas of data sharing, integration, and management. We will demonstrate the Data Governance and Management Framework implementation phases, additionally, to highlight the actual and anticipated coloration of adoption of the framework with the efficiency and effectiveness of the government services. This Framework was recognized as a best practice by Gartner and currently in process to be registered as best practice internationally by the concerned the entities.

The Figure below illustrates priority area related to the Data pillar and it's linkage with the strategic pillar of the Smart Government National plan.



Figure 2Data as a priority area in the UAE National Plan.

4.2 UAE National Smart Data Framework Components, scope, aspects and domains

The UAE National Smart Data Framework supported the creation of an efficient standards environment, with guidelines to produce high-quality, reliable, and interoperable data sets, and promote standards adoption.

Vital to the success of this data framework was identifying the data stakeholders, data providers, data output receivers and service governance providers in addition to the technology enablers, to be able to coordinate across the four identified key stakeholder groups to ensure the framework can be adopted and implemented.

The UAE Smart Government; followed the agile approach while developing the data framework. Although, 13 data standards needed as a best practice of data management; the smart government decision was to commence with most important aspects to ensure the data quality. By prompting the government entities to develop their own data catalogues and inventories, with proper classification for privacy and security matters, in addition to set the right permission and metadata for the attributes of each data set; to facilitate the data exchange.

The figure 2 below demonstrated the domains of Data Standards tackled in the first version of the Framework:



Figure 3 Data Standards Domains in the UAE Smart Data Framework

4.3 UAE National Smart Data Framework Goals and Benefits

The UAE National Smart Data Framework sets the below as its main goals:

- 1. Improve data quality nationally, benefitting constituents as well as the government itself
- 2. Ensure efficient data sharing between government entities
- 3. Adopt common classification of data, based on openness, confidentiality and secrecy as appropriate
- 4. Provide a common basis for government data use, reuse and exchange
- 5. Increase the efficiency of government service delivery
- 6. Encourage open data sharing with the public.
- 7. Enhance the ability to gain control of government data
- 8. Enable interoperability by standardizing information sharing and establishing a best practice data architecture across government
- 9. Establish shared service platforms and re-use or re-purpose existing hardware and infrastructure when possible.

Illustrated in the Figure 3 below, the UAE National Smart Data Framework Benefits:

UAE National Smart Data Framework Benefits



Figure 4UAE National Smart Data Framework Benefit

4.4 UAE National Smart Data Framework Structure

The structure of the UAE National Smart Data Framework, was devloped and divided into the below outcomes:

- 1. **Smart Data Principles:** a clear set of strategic principles to govern the creation, management, use and reuse of data in the United Arab Emirates
- Smart Data Standards: three core standards required to facilitate Data Classification, Data Exchange, and Data Quality, while allowing flexibility to implement the Smart Data Principles. Each of these standards contains a set of documented specifications, that fall into two types:
 - <u>Dataset Processing Specifications</u>: these apply at the level of an individual dataset, specifying how that dataset should be classified, formatted and described in order to conform with the Smart Data Standards.
 - <u>Data Management Specifications</u>: these specify the business rules and operating principles that Entities should follow as they manage data.
- 3. **The Smart Data Implementation Guide**: a set of supporting Guidance Notes that entities may find helpful when implementing the Smart Data Principles and Smart Data Standards. This; will be expanded and enriched over time. In this first edition of the Smart Data Framework, the Implementation Guide focused on meeting the needs of Government Entities seeking to align their data management processes with the requirements of the Smart Data Framework.

The figure 4 below, demonstrates the UAE National Smart Data framework components and dimensions, however figure 2 presents the components of the implementation guide.



Figure 5 UAE National Smart Data Framework Structure

The Figure 5 below, exemplifies a typical process that an Entity might go through, supported by the five Guidance Notes, to be implement by the government entities to comply with the Smart Data Framework:



Figure 6 UAE Smart Data Management Framework Implementation Guide Components

4.5 UAE National Smart Data Framework Principles & Imperatives

The UAE National Smart Data Framework outlines a common basis for managing data that enables interoperability and exchange among entities.

Development of the Smart Data Framework has been driven by five imperatives:

- Start with user needs: Data standards only have value if they are used and they will only be used if they meet the requirements of potential users, providing them with practical tools to help address their business needs.
- 2. Take a principles-based approach, and don't be prescriptive about process: At the core of the Smart Data Framework are a set of principles for the management and use of data. All Government Entities are expected to follow these principles, but with flexibility on how best to tailor them to the needs of their Entity.
- Build on international best practices for smart data: The development of this Smart Data Framework has been informed by the relevant international open standards on:
- 4. Contextualize those international best practices for the UAE. The Smart Data Framework leverages the work done on data standards by United Arab Emirates federal and local government entities, and ensures that international best practices are applied in ways that fully meet the needs of the United Arab Emirates.
- 5. Technology neutrality. The Smart Data Framework does not specify physical system details. The underlying IT infrastructures which hold and deliver data can be configured in many ways, and the principles and standards set out in the Framework are independent of this.

The principles for smart data that every government entity should embed within its own governance systems and business processes cover the following topics and as per the figure 6 below:

National Smart Data Strategic Principles – Des Siption

Data as an asset • Data considered as a collective national asset Sharing and re-use of data • Maximize sharing and of re-use United Arab Emirates data. Duplication of data • Avoid duplication and inconsistencies of data 'single source of truth.' Open Data publication • Publish non-personal data openly whenever possible. Privacy, Confidentiality, and Intellectual Property Rights • Protect privacy of individuals, the confidentiality of organizations, and the legal rights of intellectual property holders Open standards • Utilize open standards to enhance discoverability, interoperability and consumption the data as a service. Data quality • Improve data quality and accuracy)	<u> </u>	-0
Sharing and re-use of data • Maximize sharing and of re-use United Arab Emirates data. Duplication of data • Avoid duplication and inconsistencies of data 'single source of truth.' Open Data publication • Publish non-personal data openly whenever possible. Privacy, Confidentiality, and Intellectual Property Rights • Protect privacy of individuals, the confidentiality of organizations, and the legal rights of intellectual property holders Open standards • Utilize open standards to enhance discoverability, interoperability and consumption the data as a service. Data quality • Improve data quality and accuracy • Maximize data insights derived • Maximize data insights derived	Data as an asset	Data considered as a collective national asset	
Duplication of data • Avoid duplication and inconsistencies of data 'single source of truth.' Open Data publication • Publish non-personal data openly whenever possible. Privacy, Confidentiality, and Intellectual Property Rights • Protect privacy of individuals, the confidentiality of organizations, and the legal rights of intellectual property holders Open standards • Utilize open standards to enhance discoverability, interoperability and consumption the data as a service. Data quality • Improve data quality and accuracy • Maximize data insights derived	Sharing and re-use of data	Maximize sharing and of re-use United Arab Emirates data.	
Open Data publication • Publish non-personal data openly whenever possible. Privacy, Confidentiality, and Intellectual Property Rights • Protect privacy of individuals, the confidentiality of organizations, and the legal rights of intellectual property holders Open standards • Utilize open standards to enhance discoverability, interoperability and consumption the data as a service. Data quality • Improve data quality and accuracy • Maximize data insights derived	Duplication of data	Avoid duplication and inconsistencies of data 'single source of truth.'	
Privacy, Confidentiality, and Intellectual Property Rights Protect privacy of individuals, the confidentiality of organizations, and the legal rights of intellectual property holders Open standards Utilize open standards to enhance discoverability, interoperability and consumption the data as a service. Data quality Improve data quality and accuracy Maximize data insights derived 	Open Data publication	Publish non-personal data openly whenever possible.	
Open standards • Utilize open standards to enhance discoverability, interoperability and consumption the data as a service. Data quality • Improve data quality and accuracy • Maximize data insights derived	Privacy, Confidentiality, and Intellectual Property Rights	Protect privacy of individuals, the confidentiality of organizations, and the legal rights of intellectual property holders	
Data quality • Improve data quality and accuracy Data insights • Maximize data insights derived	Open standards	• Utilize open standards to enhance discoverability, interoperability and consumption the data as a service.	
Pata insights • Maximize data insights derived	Data quality	Improve data quality and accuracy	
	Data insights	Maximize data insights derived	
Collaborative governance • Adopt collaborative governance mechanisms	Collaborative governance	Adopt collaborative governance mechanisms	
Continuous improvement Continually adopt improvements	Continuous improvement	Continually adopt improvements	

Figure 7UAE National Smart Data Framework Principles

4.6 UAE National Smart Data Framework Governance

This process is a recommended not mandatory one. An individual entity may decide to follow a different approach in some areas, provided that this still results in alignment with the UAE Smart Data Principles and conformance with the UAE National Smart Data Standards

The Figure 7 below summarises the process that Government Entities are recommended to follow when establishing governance for their Smart Data program. This is followed by further detail on each step.



Figure 8 UAE National Smart Data Governance Roles- on the entity Level

It is the responsibility of each Government entity to decide how best it will operationalize the principles and standards of the UAE National Smart Data Framework within the Entity, and this includes the choice of data governance roles.

4.6.1 Smart Data Governance Suggested Roles

According to the UAE Data framework, it is recommended that each Entity establish at least the following roles or their equivalent:

• Director of Data (DD): a senior and empowered staff member, who will lead the Entity's Data program, champion and promote data management processes and effective data publication and exchange and ensure strategic goals are realised. Ideally, the Director of Data should be a member of the Entity's management board; as a minimum, they should be a senior and empowered individual with an ability to rapidly escalate key risks and issues for resolution at the highest levels in the Entity. For smaller entities this role might be performed on a part-time basis, for example by an existing member of staff but with additional assigned responsibilities.

- Data Management Officer (DMO): to report and deputy for the DD and lead on the operational work managing and coordinating required change management, processes and coordination to ensure conformance with Smart Data Framework standards. This is an important and full time role and requires the person responsible to spend a significant part of their time on smart data standard conformance.
- A suitable number of Data Custodians and Data Specialists: to act as business and technical owners of key datasets and data sources within the Entity. They will understand the contents and business value of the data, how it was collected and processes and the accuracy and quality of the data. These could be existing data owners and IT staff with new responsibilities.

The DD and DMO should identify or hire Data Custodians and Data Specialists for each core data source and/or data business unit. The DMO should set up a reporting and communication system for ensuring that work and processes for meeting the Smart Data Framework requirements can be met across the business units by suitable and qualified personnel (individuals who know about parts of the Entity's data systems). Depending on the size of the Entity, there could be many Custodians that report to a specific department or business unit Data Custodian who in turn reports to the Data Management Officer.

4.6.2 Establish governance relationships and processes

Entities should establish clear governance processes in which all relevant people and teams are clear on who is responsible, accountable, informed and consulted on all work the Entity carries out to achieve Smart Data objectives. This should be agreed between the Director of Data and Data Management Officer.

Entities may wish to consider developing a formal RACI matrix to summarise these processes, setting out for each one:

- Who is **R**esponsible for managing the process
- Who is Accountable for the business results delivered by the process
- Who should be Consulted on the process
- Who should be kept Informed about it.

4.6.3 Capacity Building

Custodians and Specialists should receive training and guidance to help them understand their role and responsibilities. They should read the Standards and Implementation Guide of the Smart Data Framework.

4.6.4 Organize and facilitate regular consultations, workshops and reviews

In order to facilitate learning and change management it may be useful to have regular workshops for data-related roles in the Entity to report on progress and highlight learnings, challenges and tactics so these can be acted upon and shared across the Entity. The DMO could organize consultations on the Implementation Guide so that the Data Custodian teams could decide which parts to use and which to amend and how the various processes should be adopted across the Entity consistently.

4.6.5 Continuous improvement

As the Entity's data maturity and business processes develop and as the Custodians, Specialists and Data Management Officer run through multiple sprints of formatting and cataloguing data to ensure their conformance with the Smart Data Standards, the Entity should continue to refine the roles and responsibilities of its data staff. The Director of Data should keep the effectiveness of governance arrangements under review, agreeing changes with the Entity's Management Board as required.

4.7 UAE Data Management Implementation Roadmap

The UAE National Smart Data Management framework through its implantation guide advised the government entities to start with the below steps:

- 1. Establish the Entity's data governance roles and processes
- 2. Build a roadmap to set out the key data management and change management actions that will need to be taken across the Entity
- 3. Map out key datasets within an Entity-wide Data Inventory (if that does not already exist)
- 4. Prioritize which datasets need action first in terms of applying the core Data Standards
- 5. Implement the Data Standards conformance process through a series of 'sprints' through which datasets are aligned with the Standards in a phased and prioritized process over time.

The implementation detailed recommended process was as per the figure 8 below:



Implementation Journey of UAE's National Smart Data Framework

Figure 9 UAE Smart Data Framework Implementation recommended process

4.8 UAE National Smart Data Framework Implementation Obstacles, Challenges

The United Arab Emirates consists of Federal Government and 7 local governments, the obstacle was to develop a framework which is broad enough to cater for the federal government with the alignment of the local governments published data management initiatives and legislations.

The below may be considered the main key challenges as:

- Insufficient engagement of stakeholders to the programme.
- Failure to meet the strategic objectives of the programme.
- Lack of business ownership for Data Stewardship that define data and govern the use, security and dissemination of data.
- Inability of Entities to enforce data quality due to lack of data management skills and capability.
- Cost control during the life of the programme.
- Capacity Building for the people may take long time impacting the implementation of the programme.
- Ineffective programme governance and operating model due to lack of programme management skills
- Lack of clarity around integration of Entities projects, Data Management Programme governance.
- Design of thoroughbred Data Management Programme rather than "fit for purpose".
- Poor co-ordination of between Entities projects and their interdependencies in pursuit of the Programme goal
- Risk of choice of technologies that is not well proven in implementation.

Therefore, the UAE Data Framework project management team overcome the situation to ensure a successful implementation and adoption by following the below steps to develop the framework and ensure buy in from all Federal and local government entities in the UAE:



Figure 10 UAE Data Framework Project implementation phases

To elaborate on the above, the team revised and leveraged the existing data standards, strategies, frameworks and legislation in the local emirates, in addition to creating several consultations working groups with Federal governments, local Smart governments, international expertise(Gartner) as a third non-bias international organization, prior to finalizing the last version of the UAE National Smart Data Framework.

The below figure 10 presents, the international standards considered while developing the data framework:

International Best Practices Referenced



Figure 11 International Best Data Management practices referenced

Another main challenge after developing the data framework, the UAE National Smart government had to conduct a series of workshops and training session to the various government employees to achieve the below:

- Change Management for the data handling and managing in each government entity
- Capacity building to educate the concerned employees in each entity how to adopt the standards.
- General Awareness on Data Management and specifically the UAE National Smart Data Framework.

Moreover, the UAE National Smart Data Framework will support the emerging technologies adoption in the UAE, such as the block chain and deploy the artificial intelligence, the Figure 14 below present the Artificial Intelligence goals:



Figure 17 Artificial Intelligence adoption coloration with saving 50% of the overall expenditure

*The figure 14 copyrights is for the Artificial Intelligence Ministry in the UAE

Chapter Five: Discussion and Limitations

Having the right data governance and management fostering the standardizing of the data management and the right governance roles in government entities; will enhance the collaboration across Governments. The adoption of the data governance and management framework will facilitate sharing data and introducing services.

Smart cities are transforming now to digital cities, these means that these cities are built on data. Thus, governments need reliable, accurate and timely information to manage services and account for performance, to support the decision-making process and improve service outcomes.

Publication and sharing of data between government entities has shown to improve the data efficiency since the created data can be reused by multiple government entities, helping to reduce duplication and drive productivity.

Therefore, the quality of the data is essential at this point, justifying why a data governance and Management framework and legislations is needed covers all disciplines related to managing data as a valuable, organizational resource.

The UAE National Smart Data Framework; outlines a common basis for each UAE Government Entity to develop its own approach for managing data, in ways that provide maximum flexibility for the Entity to respond to their own business needs, yet which also enable a common approach to data classification, exchange of data, and data quality.

Through the display of the UAE data framework as a use case with a live proof of concept how the data when presented fit to the purpose on the timely manner is needed, it has a tremendous impact on the way 2 services are done, resulting to customer and stakeholders happiness and ultimate efficiency of the integrated smart services.

Data Management Frameworks includes everything from file-naming conventions to policies and practices on creating metadata and documentation for the long-term. To ensures data that underlies an organization is available, accurate, complete and secure.

Data Management Frameworks and strategies in the government will contribute to more open work environment with increased information transparency and trust in expertise by changing the default content and process working mechanisms from private to public. And encourage governments publish their data.

Due to privacy and security of data, the detailed process of integrating the data attributes creating the new set of datasets for the use case proof of concept (Bashr), couldn't be included in this dissertations, however the template of data inventory and catalogues are displayed in Appendix 2.

Another key need for the data nowadays is the data analytics and new emerging technologies governments are harnessing to improve decision making and increase the efficiency of the government as a whole.

Data lakes and warehouses, and the different modules of centralizing the data or decentralize approach and available technologies is another subject which can be discussed in terms of complexity, cost and security.

Chapter Six: Conclusion and Future Work

Conclusion

We conclude this dissertation; by emphasizing on the value of Data Management Frameworks is undisputable. It boosts the ability of data to drive services outcomes; implementing Data Framework will help achieve seamless interchange of information across government to achieve the future experience of government services by providing intelligent and interactive government services around the clock to achieve customer happiness and to support cities efforts in adopting advanced technologies and transforming future challenges into opportunities.

Smart Governments; should release that standardizing the data in a hybrid approach; to assist achieve their objects. However; government's entities are encouraged to establish their data governance roles and processes; build a roadmap to set out the key data management; and change management actions; that needs to be considered across entities. In addition mapping out key datasets; within an Entity-wide; such as Data Inventory ;(if that does not already exist). Finally Prioritize which datasets need action first in terms of applying the core Data Standards and Implement the Data Standards conformance process through a series of 'sprints' through which datasets are aligned with the Standards in a phased and prioritized process over time. By standardizing data domains, creating catalogues and data management processes across entities, services should be delivered with higher predictability and improved performance and the target state should benefit from having a standard service catalog and SLA templates for better access and transparency to services, attract, retain and develop talented Individuals.

Legislation is another aspect that needs to support the creation of data governance and management frameworks, the legal enforcement and obligations on the governments and entities in general will speed up the process of sharing and publishing the data and set the accountability of the data.

After studying the UAE use case and the new developed cities digital and citizen centric approaches, we conclude that governments need more services that are integrated not more data to fulfil its vision.

48

Future work

Major challenges in applying proper data governance, maximizing the value from data, is raised due to data regulations in some sectors and the lack of data legislation backing the framework on city and country level, therefore the legal issue should be studied further, proposing amending laws and regulation to be more compatible with the digital ear.

On the other hand, the top current data governance and management frameworks and analytics risks may be the new data privacy regulations such as European Union (EU) Data protection in The General Data Protection Regulation (GDPR), and other Data Protection Law Enforcement Directive.

The direct effect of such regulations of data frameworks in governance especially; when privacy and data protection to be researched further.

To ensure data value; a chain is guided by an efficient standards environment and will provide the necessary framework and guidelines; to enable the implementation of identified strategic areas such like Robotics, Artificial Intelligence, Nanotechnology, Quantum computing, Biotechnology, Internet of Things (IoT), 3D printing and Autonomous Vehicles and other new trends. There is a need to dig deeper on the type of data needed and whether a new characteristics of the data quality to be considered to fulfil the new technologies and maximize their benefits.

Another issue that can be researched is the dependencies of governments and organizations reliance on third parties, if not even more; as the technology providers for their systems and that amplifies of the data exposure which might result to operational and regulatory risk.

Extra framework and guidelines to adopt Advanced Data Practices like Master Data Management (MDM), Reference Data Management (RDM), Data Architecture, Data Catalogue, Data Dictionary, Data Profiling, Data Modeling, Data Security, Data Storage, Data Warehouse, Document & Content Management can be elaborated in future works.

Moreover, the talents, change management and new skills required for the data management and governance, in terms of knowledge, proposed certifications can be studied further.

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International best Practices Publications Reviewed as well:

- Published by international open standards consortium OASIS, this standard is "A managed process of ICTenabled change in the public sector, which puts the needs of citizens and businesses at the heart of that process and which achieves significant and transformational impacts on the efficiency and effectiveness of government." References are to version 2 of the standard published in 2014.
- PAS181: The Smart City Framework guide to establishing strategies for smart cities and communities. Published by the British Standards Institute in 2014, this applies the OASIS Transformational Government Framework to the specific circumstances of a city. In September 2015, the International Standards Organization voted to develop a new global smart city standard based on PAS181.
- European Interoperability Framework for European Public Services
- https://project-open-data.cio.gov
- https://www.niem.gov
- The New York City Open Data Policy and Technical Standards Manual
- The Open Data Chapter of the UK Government Service Manual, and the National Information Infrastructure

Appendix A – Glossary

Term	Definition					
Cataloguing	The process of adding metadata to datasets listed in an Entity's Data Inventory. For the UAE Smart Data Framework this includes classification, finalizing format, adding metadata and a schema, and reviewing data quality.					
UAE	the United Arab Emirates (UAE)					
Data	A structured or unstructured set of datum, facts, concepts, instructions, information, observations or measurements that shall be in the form of numbers, letters, symbols, images, maps or any other form, in a manner that allows interpretation, exchange or manipulation by individuals or computers					
Data access permission	The permit and its conditions under which the shared data may be accessed by any authorized entity or person.					
Data Classification Standard	The standard by which datasets and unstructured data can be classified into Public, Restricted, Confidential, and Very Confidential data which then impacts whether the data can be published as Open Data, exchanged between Entities as Shared Data or should be fully restricted as Closed Data.					
Data Custodian	A Data Custodian has business responsibility over their data. They should understand the value and risks associated with their data so that they can effectively prioritize, classify, and catalogue it. They will be responsible for determining whether the data should be Open or Shared and setting out the access permission rules.					
Data exchange	Sharing or providing data access to a different entity than the one producing and initially using the data.					
Data Governance	is a system of decision rights and accountabilities for information-related processes, executed according to agreed-upon models which describe who can take what actions with what information, and when, under what circumstances, using what methods.					
Data inventory	An inventory or list of the datasets controlled or owned by an Entity.					
Data Management	Refers to the disciplines and techniques to manage data as an asset.					

Data Management Officer	The Data Management Officer (or DMO) is the delivery and operational lead for an Entity's data management activities. They could report to and deputize for the Director of Data and lead on coordinating the required change management processes to ensure conformance with Smart Data Framework standards.						
Data Modelling	The creation of a model or overall description of the data in a system or used in a business process.						
Data prioritization	exchange, and in what order, within an Entity. It is recommended this is done according to a series of criteria which assess each dataset against the value and benefit of publication and readiness for publication described in the Implementation Guide.						
Data provider	Any governmental, semi-governmental, or private sector entity, or any natural person who offers the data in any form,						
Data publication	The process of making data available to others, through publication on the web, electronic platform, Government Service Bus or via an API.						
Data Quality Requirement level	A specification for the data quality requirements of a dataset (as compared to the Data Quality Principles directly or by using the Data Quality Maturity Matrix), relevant to the current use of the data or potential use of the data. Should be informed by consultation with existing and potential users.						
Dataset	A collection of data that it makes sense to group together, along with the metadata and schema that describes it. Each Entity identifies the datasets specific to supporting the needs of their respective mission or business functions. Note that a dataset is a deliberately flexible concept. A given dataset may represent an entire database consisting of multiple distinct entity classes, or may represent a single table in a database, or a map.						
Data Specialist	A role with technical responsibility over data, typically within IT or database administrator teams. They will facilitate between the IT and business teams and ensure that the data for which they are responsible meets the format and quality requirements in the UAE Smart Data Standards.						
Data Subject	Any person whose personal data is being collected, held or processed						
Data User	Any entity or person wishing to take advantage of and use open or shared data in accordance with the terms and conditions on which such data are made available.						
Director of Data	A senior and empowered staff member who will lead the Entity's Data program, champion and promote data management processes and effective data publication and exchange, and ensure that strategic goals are realized. Ideally, the Director of Data should be a member of the Entity's management board; as a minimum, they must be a senior and empowered individual with an ability to rapidly; escalate key risks and issues for resolution at the highest levels in the Entity. For smaller Entities, this role might be performed on a part-time basis, for example by an existing member of staff but with additional assigned responsibilities.						

Entity	Any organization or body defined as any of the following within this document						
Format	A standard way in which information is encoded for storage and transmission by						
	computers. It specifies the way in which data is arranged in such a way that the						
	data can be read by software applications.						
Government Entities	Ministries, bodies and entities of the Federal Government as well as directorates,						
	bodies and institutions of the Local Government.						
Government data	Electronic or non-electronic data or information of or belonging to the Federal						
	Government or local governments of the Emirates of the United Arab Emirates,						
	the public or federal bodies, or the local public institutions.						
Information and	Any useful results that are derived from data processing, that are also used for						
Knowledge	purposes of the strategy and the policy.						
Local Government	Governments of the member Emirates in the Federation.						
Local Government	Any entity that is administratively and financially appended; to the local						
Entity	government of the Emirate.						
Machine readable	A format; which can be read and correctly understood by machines. This means						
format	that it uses the symbols, rules, or conventions correctly and unambiguously and						
	conforms to an existing standard.						
Metadata	Structured information that describes, explains, locates, or otherwise makes it						
	easier to retrieve, use, or manage a data resource.						
Open data	Data published by Entities to be shared with the public freely or with minimal						
	restrictions in order to maximize public participation and stimulate creativity,						
	innovation, and economic growth.						
Principles	The UAE Smart Data Framework is principle-based, setting out a number of						
	principles to inform data management in the UAE. The term principles in this sense use the definition set out in the OASIS Transformational Government						
	Framework: "An enduring statement of values which can used on a consistent						
	basis to steer decision-making by multiple stakeholders over the long term, and						
	which are:						
	• used to inform and underpin strategy;						
	undersiood, agreed and owned by stakeholders.						
Private Information	Information; that is confidential and that relates to a natural person; that would						
	not be expected to be made publicly available without that person's choice or						
	express consent. Including; but not limited to information that can identify the						
	person's health, age, marital status, address, financial standing, religion, ethnic						
	origin, political affiliations or opinions, criminal records, trade union						
	memberships.						
Reference Data	Data that is the set of controlled values to be used in other specified areas. It is						
	unlikely to be affected by the user's business or systems, but changes should be						
	reflected in the system. A list of countries is an example of Reference Data.						

Schema Shared data	A formal description for how something should look and behave. Includes the rules for what counts as conforming to the schema. In the context of data this could be a description and example of column headings and the type of data allowed to be in the rows underneath those headings and any validation rules which should be applied (for example, check it's a number from 0 – 100 with no spaces).						
	example through the Smart Data Electronic Platform, or with Private-sector Entities. According to the UAE Model for Exchange of Classified Data within this document, data classified as Restricted or Confidential falls into the category of Shared data.						
Smart Data	Data that conforms with the requirements for data classification, data exchange, and data quality set out in the UAE Smart Data Standards.						
Smart Data Electronic platform	The electronic data systems that allow electronic connectivity of services and/or collection, storage, analysis, exchange and/or availability of data from multiple sources between the connected parties according to given and defined privileges after being authenticated by a data provider in a secure network system. e.g. The Government Service Bus and UAE Open Data Portal are examples of systems within the Federal Smart Data Electronic Platform.						
Structured Data	Structured data refers to data that is organized and constrained by a pre-defined model describing it. Structured data is often machine encoded but can equally be human readable. The structured nature of the data enables the data to be indexed and searched, and makes it more widely available, greatly increasing its potential value.						
UAE Smart Data Framework	A suite of interrelated documents (UAE Smart Data Principles; UAE Smart Data Standards; UAE Smart Data Implementation Guide); which together provide a common basis for individual UAE Entities; to manage data. In ways that provide maximum flexibility for each Entity to respond to their own business needs yet which also enable a common approach to data classification, exchange of data, and data quality.						
UAE Smart Data Principles	The part of the UAE Smart Data Framework that sets out a clear set of principles to govern the creation, management, use and reuse of data in the UAE.						
UAE Smart Data Standards	The part of the UAE Smart Data Framework that sets out the core standards around data classification, exchange and data quality to ensure UAE data is reliable, interoperable and fit-for-purpose.						
UAE Smart Data Implementation Guide	The part of the UAE Smart Data Framework that sets out a set of supporting guidance and tools to help entities manage their data and implement the Smart Data Standards and Principles.						
Unique identifier	With reference to a given (possibly implicit) set of objects, a unique identifier (UI) is any identifier, which is guaranteed to be unique among all identifiers used for those objects and for a specific purpose. For example: serial numbers, URLs (domain addresses), codes from a registry, etc.						
Unstructured data	Unstructured data refers to data that is not organized or constrained by a pre- defined model describing it. Unstructured data is often free text in documents, graphs and tables in spreadsheets, or video and audio files.						
User-focused	An approach to the design and delivery of government data and services that is driven by the needs of their users rather than the government's organizational structures. Also known as customer-centric.						

Appendix B – Data Inventory and Catalogue Sample Template

Dataset Title	Dataset Description	Which service(s) does the dataset serve?	Main Attributes	Responsible Department	Dataset Custodian Name	Dataset Custodian Email	Dataset Custodian Phone	If the dat:



Figure 20 Data Inventory Sample Template