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Get Started in Data Governance and Data Stewardship

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Abstract

Data is growing rapidly in this new era where almost all organizations need to handle data with care, as data is an asset for organizations. A data governance program is essential for data quality management to improve data-driven insights that enable an organization to make better decisions. To implement an effective data governance program, data stewardship responsible for data management plays a vital role in it. Therefore, this study aims to provide fundamental information on successfully getting started in the data governance and data stewardship program. The literature reviews, principles, roles and responsibilities, framework, implementation, and maturity model assessment will be discussed in detail.

Keywords: *Data Governance, Data Management, Data Stewardship, Data Quality, Literature Review*

1. Introduction

In recent times, the volume of data used within associations has increased dramatically, playing a critical part in business operations. Data has an impact on both operational and strategic decisions. For data to be viewed as a valuable asset, it's also important to understand how to govern it [1]. Many businesses now regard data as a source that, when properly measured and guided, can be considered a valuable asset. Data governance is the practice of developing and implementing policies, standards, and procedures to ensure that data consumption is successfully governed [2]. Data governance is a set of processes, responsibilities, programs,

norms, and measures that ensure that information is used effectively and efficiently to help a company achieve its goals [3]. Data is at the core of digital transformation, but before considering new technologies, businesses must first assess their current infrastructure to determine the state of their data. Companies that do not have accurate data risk losing money and losing their brand value. However, utilizing accurate data can result in significant increases in revenue and overall business growth [4].

Because of the enlarging volume of data from various sources, data inconsistencies must be linked and addressed before conclusions are made grounded

on incorrect data. Companies are implementing more self-service reporting and analytics, necessitating the creation of a standard. The ongoing consequences of regulations such as the General Data Protection Regulation (GDPR) put additional pressure on businesses to implement a strong data protection strategy. Organizations must overcome the challenges posed by inaccurate and incomplete data [5]. As an example, from the marketing and sales department, client data can be anatomized and used to design an applicable marketing strategy using coffers and data governance. Additionally, possible clients can be targeted, putting the company in a better position. customer service, finance, and functional conditioning will be bettered as well, performing in happier guests [2].

Despite the importance of data governance in achieving data quality, the scientific community has paid little attention to it. Organizations can use data governance to ensure that data and information are managed properly, delivering the right information to the right people at the right time. Data governance is a complex task, and many governments' data governance actions have failed in the past. The principles of data governance include data operation association, assuring alignment with business requirements, ensuring compliance, and ensuring a common understanding of data. nonetheless, data governance shouldn't be viewed as a" one- size-fits-all" approach; rather, data governance must be institutionalized through a formal organizational structure accommodated to a specific association [6].

Data flow and logic may not follow an organization's structure, which is a common issue with data governance. A misalignment between organizational structure and data usage can easily lead to data silos, duplications, ambiguous responsibilities, and a loss of control over data throughout its life cycle. Data governance approaches include planning and control, organizational, and risk-based data governance. These methods are not mutually exclusive and can be used in conjunction. The annual planning and control cycle is the foundation of the planning and control approach, which is widely used by IT-governance frameworks. Each cycle begins with the definition of objectives, budget allocation, and the definition, implementation, monitoring, and evaluation of projects. This approach, which employs the top-level design principle, establishes organizational structures for data governance and regards data governance as a defining authority [7].

Data stewardship is innovated on the science and practice of data collection and analysis, and it reflects the values of responsible information use. Data stewardship is an approach to managing data that can be used to identify individualities, regardless of how it's collected. Data stewardship is an approach to managing data that can be used to identify individualities, regardless of how it's collected. Data stewardship is a set of data management methods that include data accession, storehouse, aggregation, and deidentification, as well as data release and use procedures. The term" data steward" refers to a fiduciary relationship with data that are based on a data director's fidelity to the individualities and realities whose data is stored in and managed by the system. The process of conceptualizing and carrying out stewardship responsibilities, similar to the policies and approaches that enable stewardship, is defined as data governance [8].

Some fundamental principles guide data governance and stewardship. Data is a critical strategic asset that needs to be managed. When data is not managed properly, it frequently becomes duplicated, of poor quality, and fails to support the valuable

insights that come from good data. Stewardship and accountability are required for data management. Under this principle, individuals must be designated as data stewards and caretakers. Data stewardship metadata is valuable and must be preserved. The designation of specialized data stewards from all enterprise application data stores, data storages, data marts, and extract, transform, and load (ETL) processes are known as data stewardship. Aside from that, data stewardship decisions have been clearly documented and communicated to interested parties through approved channels [9].

When data is properly managed, major enterprise initiatives can be completed with fewer steps, fewer errors, and less unused effort. The business data stewards play serious parts in all of the initiatives. Existing policies and procedures that have become part of the corporate culture are included in data stewardship. The goals of data stewardship are executive approval and support. Executives must openly support the policies and actively advocate for their implementation, as well as the creation of procedures to carry them out. Data stewards also provide regular written training for all parties involved, including stewards, project managers, and creators [9].

2. Background

A few studies have been made to study data governance and data stewardship. Data stewardship is a term that comes from the science and practice of collecting, distributing, and analyzing data [7].

Doris Hooi-Ten Wong et al. stated in their study that starting the data governance and data stewardship program gains when the association realizes data is a significant asset that can advantage them and generate value in return. The association will be suitable to set a clear objective with discipline in standardizing the association's objective of organizing and managing data information and assets across people, processes, and technology by establishing data governance. As a result, data stewardship was introduced to ensure the success of the data governance program, whereby the standard operational and activities throughout the process across all levels of people, business, and technology is carried out in accordance with the standard policy or aims of data governance, while also ensuring the quality of data information with proper data management [2].

Another study from Ge Peng et al. is being conducted as part of the OneStop-ready process to give evidence- based dataset stewardship maturity information for search and discovery using the Data Stewardship Maturity Matrix (DSMM). The dataset maturity information can be used by end-users to make informed decisions about their specific data use requirements. The OneStop project was established to assist the National Oceanic and Atmospheric Administration (NOAA) in its efforts to improve legacy data discovery and access services [9].

A study by Xing Li on efforts in West China to improve data stewardship and service for environmental and ecological science data. The goal of this research is to collect, manage, integrate, and disseminate data on the environment and ecology in western China. This research also concludes that data sharing is critical. Furthermore, this study discovers that the WestDC has achieved its goals in the following areas after several years: the creation of a technically sound data portal

that aids in data sharing, the creation of a technically sound data portal that aids in data sharing, the creation of knowledge storage and online scientific collaboration tools, the collection of large volumes of innovative scientific data that are useful in environmental, ecological, and geoscientific exploration in western China, and the facilitation of stable ad hoc collaboration [4].

Aside from that, there are studies on Data Stewardship in the Earth Sciences by Robert R. Downs et al. For over 15 years, the Federation of Earth Science Information Partners (ESIP) has worked in the Earth Sciences to make Earth science data more discoverable, reachable, and practical by more people. The ESIP Federation, an open community of researchers, data managers, funding agencies, and others that has been actively working for nearly two decades to improve the state of data access, interoperability, and stewardship, has provided much of the impetus for improvements in data management across U.S. organizations. As a community, ESIP has created a number of articles, white papers, best practices, and other products that have been widely accepted and used by government agencies and scientific data centers. ESIP is still involved in related activities around the world to improve scientific data generation, administration, distribution, use, and citation. As part of its commitment to open projects that facilitate the use of Earth science data, the ESIP community seeks contributions from individuals and organizations with similar interests to improve techniques for facilitating the generation and use of scientific data [11].

Paula Jansen et al. conducted research on data stewardship for healthcare professionals. This study focuses on long-term clinical research using findable, accessible, interoperable, and reusable (FAIR) data management, archiving, and reusing by third parties. This study also stated that proper data stewardship has become an essential component of clinical research [12].

The process of conceptualizing and carrying out stewardship responsibilities is referred to as data governance in another study by Sara Rosenbaum. The question is whether legal barriers to data access and use will begin to fade as the conception of health information data stewardship matures in a technologically enabled world. The two underlying assumptions of health services research are that solid evidence can be generated from health and health care data on patients, providers, and health care systems and that this data will be available. Data stewardship is a concept that is based on the science and practice of data collection and analysis, and it embodies the principles of transparency and accountability. Health data stewardship is required, according to experts, for entities that acquire, hold, and aggregate information before releasing it for research purposes. "Trust and competency; technology adoption; and new data exchange models and skills for managing health information that includes the patient as part of the data supply chain" are required for data stewardship. The distinction between data ownership and data access suggests two distinct approaches to resolving the issue. The first option, in keeping with the concept of health information ownership, would be to charge for data access. Another approach is to treat healthcare information output as a public good, accessible to entities structured and operated in accordance with data stewardship principles [7].

Christian Hitz et al. conducted research on the impact of data stewardship leaders on vertical integration in governance programmers. The study investigates the effect

of data stewardship leadership on vertical data governance integration programs. Inadequate business user involvement in data governance workflows and vertically integrating stakeholders at the system and function levels are ongoing challenges. This influences the program's success. Data Stewardship Leadership has an effect on Vertical Integration, according to the research findings. Effective data governance enables the utility to be extracted from controlled data use, which is critical in the emerging data economy. Governance must succeed in involving and aligning with business stakeholders in order to add value to traditional information operations [13].

3. Findings

According to the previous studies reviewed on data governance and data stewardship, the fundamental components such as the principles, roles, and frameworks are important to ensure an organization starts the data governance and stewardship program efficiently and effectively without much burden. The literature reviewed are then categorized into four subsections to show the clarity of the overall literature findings.

3.1. Principles of Data Governance

There are four essential data governance principles identified in the previous study found to start an effective data governance program which are organization, alignment, compliance, and common understanding [6].

Data governance is proven to have various organizational dimensions, including organization form, goal, transformation process, and measurement for changes [6]. Organization form refers to the specialized formal organization structure that can assign roles and responsibilities clearly. Critical issues identified in the governance program need to be solved in the structure of an organization itself. The decision-makers should explicitly design the form of structured governance to meet certain goals and objectives of an organization. Meanwhile, organization goals can be divided into two categories which are formal and functional goals. A formal goal acts as a measurement to measure the value of data consisted in an organization’s assets, while a functional goal is the duties that are represented by the decision rights and must be achieved by an organization. Another organizational dimension that is closely related to the measurement of changes and transformation process which involves the establishment of a simple and clear pattern to ensure governance policies are handled well.

Data governance activities must be aligned based on the organization’s objectives and need to ensure the business can address critical issues like the development of customers’ single view or lack of data quality [6]. Alignment is essential for an organization to obtain sufficient funds and sponsorship to develop the planned governance activities. The data should be able to transform into meaningful information for users to build insights and make better decisions. In effect, data can act as a powerful asset that is reusable for an organization since data visualize the operational outcomes into helpful information.

An organization must ensure that the planned data governance program comply with the data processes and relevant policies. A specific authority should be assigned to create data policies through a structured data management procedure. Both the business management and IT department need to collaborate and identify the governance policies that best suit the scope of an organization. In governance program, the term accountability is closely connected to data protection and data stewardship in the data management system and enables an organization to explore more opportunities.

An organization must have the ability to understand the data management process to implement the data governance program successfully. Lack of data understanding might cause the failure of an IT project since data is either incomplete or misrepresented. Therefore, data stewards should equip both IT skills and business- related knowledge to solve misleading data issues. Metadata, which refers to data information, needs to be well managed by the authority as changes in the business environment might lead to changes in the business operation's method.

3.2. Roles and Responsibilities of Data Stewardship

The typical types of data stewards involved in a data stewardship program are business, technical, project, and domain data steward [2]. Figure 1 shows how the interaction takes place between different data steward types in the data management procedures.

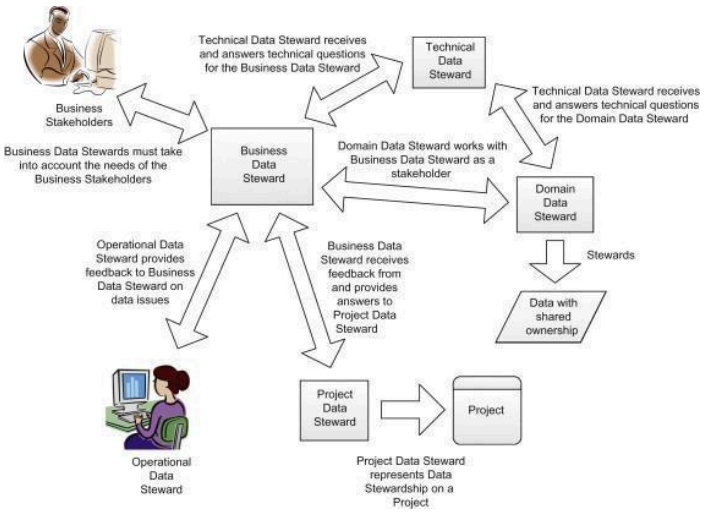

Figure 1. Types of Data Steward

The first type of data steward is business data steward who focuses on transforming data into meaningful and useful information for the decision-making authority to have a broader selection of suggestions. Business data steward are a group people that come from various business backgrounds like finance, economics, accounting, and human resource. From reference [2], the roles of the business data steward will be completed by the job position of Business Analyst and Data Analyst in an organization. Business data stewards must have the capability to communicate and collaborate with the other data steward in the organization to ensure the data governance program is conducted smoothly. For instance, the business data steward needs to address issues the project data steward faces through the feedback collected.

On the other hand, technical data steward also plays a vital role in data quality management. Technical data stewards are people who are equipped with technical skills, and their job tasks focus on data stores, business intelligence tools, and technical procedures like ETL. At the same time, they will also be equipped with IT resources that can support their efforts effectively. The responsibilities of technical data steward will be completed by the job position of programmers, application owners, and database administrators in an organization. Technical data steward also need to have collaborative with other data steward within an organization to fully support the data governance program implemented. For instance, business and domain data stewards will refer to technical data stewards whenever data management issues occur in the system. The technical data steward will then check the issue in detail and provides solution to address these technical questions.

Another type of data steward involved in data stewardship is the domain data steward who is responsible for a specific reference data and business data entity attributes management. They aim to provide support for the business data steward to reduce their burden on data governance programs, especially those complicated and comprehensive ones. This kind of data steward usually needs a strong sponsorship to support the team's function. Domain data steward also needs to work with the technical data steward to ensure data quality issues can be solved immediately throughout their jobs.

Project data steward involved in the data stewardship council focus on the data stewardship tasks on a single project. A project data steward is one of the most challenging positions in data stewardship since they need to consider both the project needs and data stewardship program needs equally. They need to collaborate closely and consistently with the business data stewards to ensure that issues faced in a particular project, such as data quality and data usage, can be identified and solved by the business data steward within a limited time. The project data steward only can function with the fund provided by the particular project itself and thus do not entitled decision making power in the council.

The data stewardship council is made up of various types of data stewards and aims to support the application of a data governance program effectively. Collaboration is of utmost importance for different data steward teams to work well together. Figure 2 summarizes the prominent roles assigned to each type of data

steward.

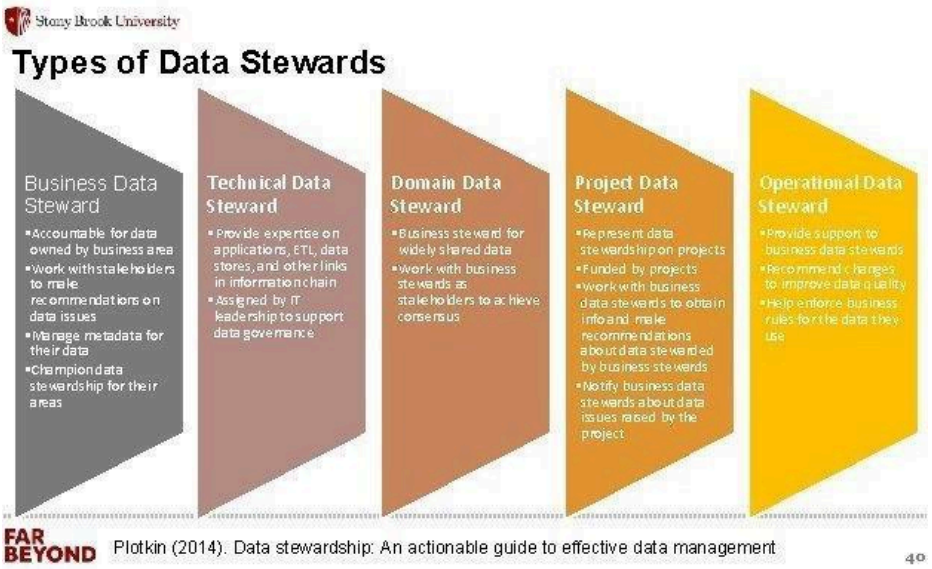

Figure 2. Types of Data Steward and the Roles

3.3. Data Stewardship Model

To establish an effective and successful data governance program, the development of a data stewardship model contributes a significant impact. Therefore, it is essential to build a well-developed data stewardship program that meets the organization's mission based on fundamental components. Based on reference [14], the data stewardship programs can start with four main first steps which are responsibility assignment, data steward definition, data steward identification, and stewardship coordination specification. Roles and responsibilities must be first assigned to each data steward to ensure data steward knows their own tasks without duplicating the data management process, such as multiple data stewards managing the same datasets with different methods. An organization needs to develop a written procedure or policy that provides clear details on each data steward's designation. Besides, data stewards can be identified through a publication of a roster that states the key person responsible for each operation or function in the organization. The development of a formal specification about the interaction flow between different types of data stewards can be implemented to enhance the communication process.

3.4. Data Stewardship Maturity Framework

The Data Stewardship Maturity Matrix is a widely used framework to consistently measure the data stewardship maturity in an organization based on nine core components. These components include accessibility, usability, data quality assurance, data quality monitoring, data quality assessment, data integrity, traceability, preservability, and production sustainability [9]. The maturity stewardship measured based on each component is on a scale that consists of five levels: ad hoc, minimal, intermediate, advanced, and optimal. The maturity measurement of data stewardship is one of the essential parts of a successful data management system. Each of the measurement components involved in the DSMM

enables a data governance program or project to determine specific stewardship requirements that suit the program and accurately comply with the stewardship practices. The DSMM can effectively and efficiently access individual dataset's stewardship maturity effectively and efficiently to ensure metadata quality for better decision-making.

4. Applications

After the exploration of related works, understanding the principles of data governance, data stewardship, the differences between the two program and maturity framework, the next step is to explore the applications on the matter in the real organisations. This section will be break down into three parts to detailed out on the approach taken by organisations or business from different departments and sectors in terms of implementing data governance, introducing data stewardship plan and conducting maturity assessment model to better govern their data to support the business goals and objectives.

4.1. Implementation of Data Governance

As mentioned in the previous part of this paper, data governance plan or program is important to ensure that organisations data is properly measured and guided according to policies, standards and procedures set out by the organization. The Federal Highway Administration (FHWA) under United States Department of Transportation (U.S.DOT) initiated their data governance plan with a six steps approach which are mapping data programs to business objectives, developing data governance model, developing data governance charter, developing data catalogue and assessing data governance maturity [15]. The details of the steps are further summarized in Table 1.

Table 1. Summarize FHWA Data Governance Approach

Steps	Detail
Step 1- Map data programs to business objectives.	Defining relationship between mission and business objectives of stakeholder office and how they map to data program managed by the office
Step 2- Define stakeholder roles and responsibilities.	Defining roles and responsibilities for data governance based on establish hierarchal relationship between data management, data governance and data stewardship. Roles defined includes Data Governance Team, FHWA Data Governance Advisory Council, Office of Operations Team leader, Data Business Owners, Data Stewards, Community of Interest, Internal and Community of Interest, External.
Step-3 Develop data governance model.	Establishing data governance model diagram once step 1-mapping data programs to business objectives is accomplished.
Step 4- Develop data governance charter.	The data governance charter will set the mission, vision, purpose, goals and data

	management policies within U.S.DOT stakeholder office.
Step 5- Develop data catalogue.	The catalogue provides centralized location for information of data used by stakeholders involved with roadway travel mobility data programs. The catalogue should be reviewed and revised to make sure it is timeless.
Step 6- Assess data governanc e maturity.	Data management maturity model to assess the performance of the organization, benchmarking to understand issue or process and identifying the initiative to be taken to achieve the set goal.

In simpler word, FHWA data governance implementation approach starts with identifying the vision, goals and objectives of the organization, the organizational structure followed by reporting process, charter, data set inventory and end with gap analysis to understand the performance and taking further action needed.

4.2. Implementation of Data Stewardship

Data stewardship is important to establish a successful and effective data governance program. According to [14], data stewardship programs can be made to focused on different aspects. Some user will focus on policy while other may targeted the data definition, workflow and still other on risk management. Nevertheless, majority of the data stewardship programs focuses on four essential steps which are assign responsibility, define data steward, identify the data stewards and specify the data stewardship coordination. The details on this approach are further detailed as follow:

a. Assign responsibility: Assigning managers of operational areas that managing vita data as data steward.
b. Define the Data Steward: Defining the data steward designation entails in a written procedure or policy.
c. Identify the data stewards: Publishing chart od data stewards to clearly establish the point person to be consulted according to area.
d. Specify stewardship coordination: Specifying the expectation on the methods of collaboration and cooperation of data stewards with each other.

The four steps approach mentioned above is utilized by Educause Center for Applied Research (ECAR) working group in establishing their data stewardship program for administrating of data [14]. To develop an affective program for the organization, the program was first divided into few components of focus including purpose, people, policy and practice. To provide the overview of components taken into account by ECAR working group, explanation on each component is tabulated in Table 2.

Table 2. Components of ECAR data stewardship program

Component	Detail
Purpose	Few key objectives are to ensure:

	• Reliable, consistent and high-quality institutional data • Appropriate accessibility of data • Compliance of institutional management practices in terms of privacy and security with federal and state legislation as well as industry regulations. • Compliance of management practice with standard and best practice in higher education.
People	Data stewardship may consist roles to support data steward which includes Data Guardian, Data Trustees, Data Custodians and End Users. These designees may have additional relationship with individuals that might not be a data steward such as Institutional Research Office, Institutional Archivist, Institutional Audit and Risk Management Personnel, Data Governance Personnel, Information Security Office and Data Center/Information Technology Unit.
Policy and practice	Concerning exercise of authority, control and shared decision making of data as well as how it is implemented. The procedures may be developed by steward but typically the data custodians are responsible of following those procedure.

4.3. Maturity Assessment Model

Maturity Assessment is done to access where the organization stands with respect to implementing their process, comparing their performance with target goal to provide insights that assist in identifying the next step. Few popularly used maturity models are Capability Maturity Model (CMM), Gartner Maturity Model and IBM Maturity Model [16]. CMM and IBM maturity model consists of five stages while Gartner model consists of six levels. The difference in the maturity assessment is shown in Table 3.

Table 3. Maturity Assessment Model

	CMM	Gartner	IBM
Level 0		Unaware: No awareness on data governance activities.	
Level 1	Initial: Undocumented, uncontrolled	Aware: Understand and acknowledge value of information and	Initial: Little to no awareness on

	and disorganized.	enterprise management.	importance of data.
Level 2	Repeatable:	Reactive: Sharing of information between teams.	Managed: Realizing importance and benefits of data.
Level 3	Defined: Defining standards and consistency.	Proactive: Management system is accepted and implemented.	Defined: Defining and integrating data regulation and management guidelines with organization process.
Level 4	Managed: Measuring controlling and organizing data.	Managed: Standard and policies are understood and implemented.	Quantitatively managed: Data governance guideline and principles fully followed in projects.
Level 5	Optimized: Improving performance continually.	Effective: Using enterprise information management to improve productivity.	Optimized: Data governance is enterprise-wide effort to improve productivity

Based on white paper released by Informatica, four characteristics are used by the company in defining maturity level of organizations which are leadership, scope, measurement/metrics and data governance management. The company defined six broad stages of maturity based on CMM approach with an additional of level 0 that account for decreasing number of organizations that remains unaware on the needs of data governance. The stages developed and being used by Informatica is shown in Figure 3.

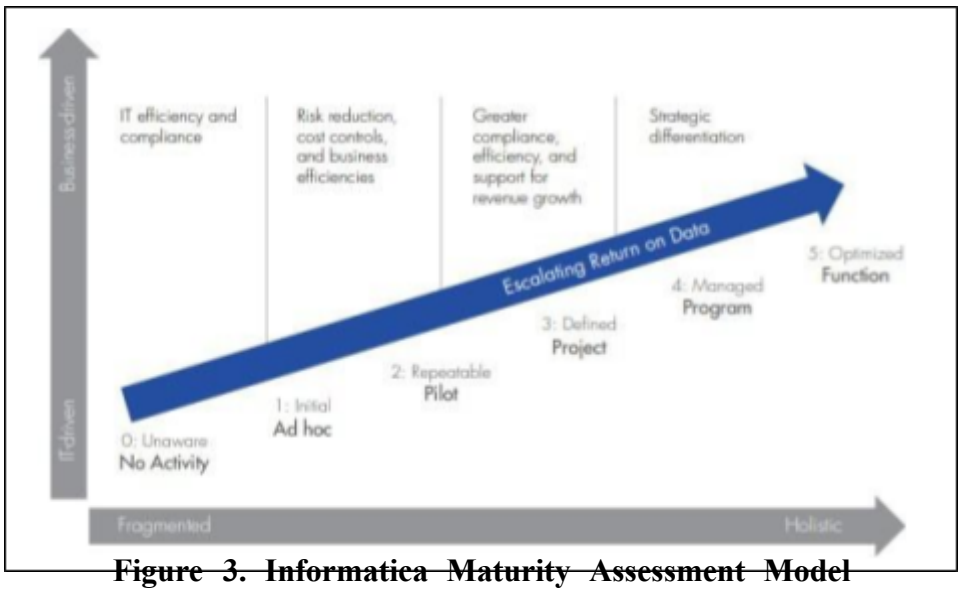

Figure 3. Informatica Maturity Assessment Model

[17] 5 Conclusion

In a nutshell, data governance and data stewardship is closely related with each others to ensure data and information in an organization is properly managed. Data governance is a challenging task that includes principle of data management organisation, ensuring alignment with business needs, ensuring compliance, and ensuring a common understanding of data. On the other hand, data stewardship refers to a method of managing data, particularly data that can be used to identify individuals, regardless of how it is collected. Data governance and data stewardship enables the organization to achieve their goal of enabling better decision making, reducing operational friction, protecting the needs of stakeholders, standardizing procedures and reducing the cost. A good data stewardship program contributes significantly to the establishment of effective data governance program hence having a well-developed data steward program that met the organization goal and mission based on fundamental components are essential. The performance of the programs can be assessed by conducting maturity assessment that measures the maturity level of program in an organization which may contribute to improving the overall state of governing data. In conclusion, managing data and information properly with the proper data management program with assigned data responsibility across the organization may improve the overall performance of the organization that lead to achieving their objectives.

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